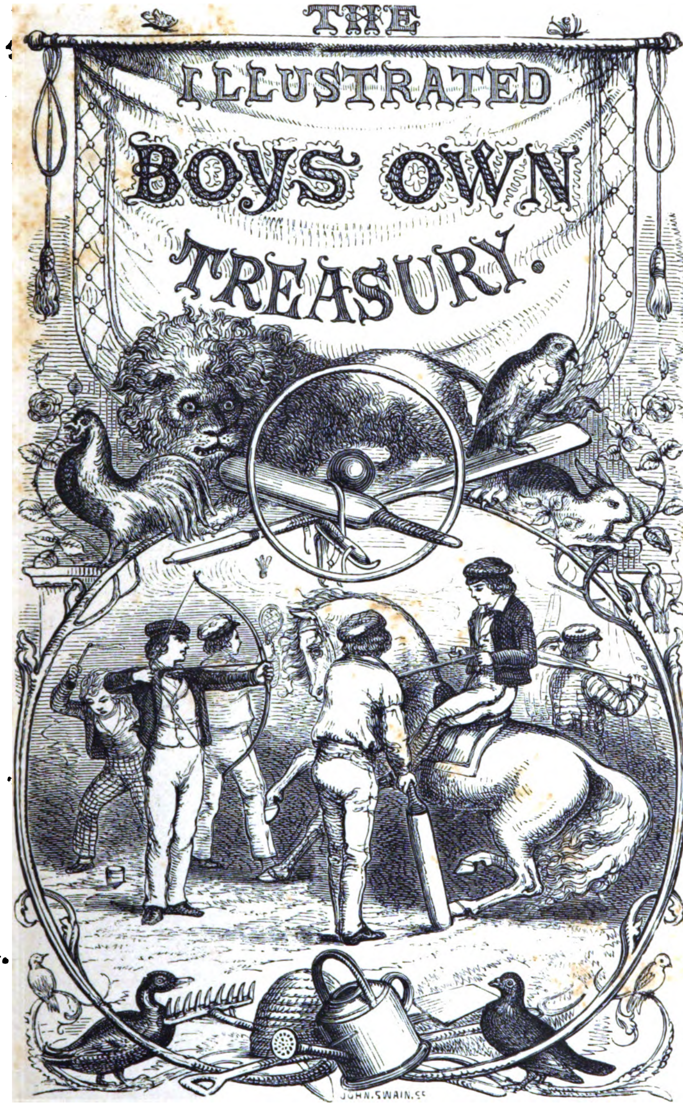

JOHN SWAIN


THE
ILLUSTRATED
BOYS OWN
TREASURY.
JOHN. SWAIN. Sc

THE ILLUSTRATED

BOY'S OWN TREASURY

OF

I.—SCIENCE,	IV.—CONSTRUCTIVE WONDERS,
II.—DRAWING,	V.—RURAL AFFAIRS,
III.—PAINTING,	

VI.—WILD AND DOMESTICATED ANIMALS,

Outdoor Sports & Indoor Pastimes

FORMING A

COMPLETE REPERTORY

OF

HOME AMUSEMENTS & HEALTHFUL RECREATIONS

EMBELLISHED WITH

FIVE HUNDRED DESCRIPTIVE ENGRAVINGS.

LONDON

WARD AND LOCK

158, FLEET STREET

MDCCCLX.

PREFACE.

Boys' Books, like their companions, should be chosen with scrupulous care. Idle, purposeless reading, for mere amusement sake, is the very worst habit youth can fall into. It enervates the mind, enfeebles the reflective powers, and destroys the interest which it is so desirable to maintain for sound instruction.

There is a common saying that "boys will be boys," but it is equally true that boys will be men, and have to be prepared for that sphere. With the object in view to aid in this preparation, as well as to be an abundant source of entertainment, we have, in the "Illustrated Boy's Own Treasury," gathered from the wide-spread and teeming gardens of knowledge, treasures that will serve to amuse and strengthen the mind, and kindle and direct the energies. We commence with—

The Marvels of Science. If it be important—as who will deny? that the young man should enter on active life with a clear understanding of the most important principles of science, and that he should have some familiarity with the details of the chief scientific inventions of our age, then it must be a clear benefit to the boy to have these principles and details presented to him here, not as formal lessons, but divested of the technieal and abstruse.

Then again the tastes of boys for the fine arts cannot be sufficiently cultivated by task-work, or direct teaching. It is as pleasurable pursuits that Drawing and Painting take hold of the fancy. We believe artistic tastes to be of great value as a means of refinement, and as quickening the perception of the beautiful, in Nature as well as in Art; for it has been well said a thousand beauties that afford exquisite pleasure to those possessed of some artistic knowledge are lost upon such as have it not.

We also think it important to familiarise the boy in his recreations with the great Constructive Wonders of past ages. The Pyramids—Great Wall of China—Cradle of Noss—the Lighthouses—the Breakwaters—for the constructive faculties have been, and still are, too much neglected in popular education.

ANIMAL HISTORY forms, too, an important section of our volume. Benevolence to the inferior animals, a quality so admirable in the yougg lords of creation, and absolutely essential to every just and amiable mind, could never be adequately taught by any amount of formal instruction without other influences.

We sincerely hope that the glimpses of Wild and Domesticated Animals, in their natures, homes, and haunts, may stimulate the sympathy and curiosity of boys to seek larger information on this interesting subject.

Intimately blended with the study of animal life is a love of rural nature, and the delight in RURAL AFFAIRS. We would have our boys well informed, and practically too, on all the pleasing and invigorating labours of the field, the garden, and the wood. Ploughing, Sowing, Reaping, and Planting, all these things are mines of pure enjoyment, which none would willingly lose who are sufficiently cultivated to appreciate them.

The boy's physical training should go hand in hand with his moral culture. We have not forgotten this in our "Treasury," and have devoted a large space to OUT-DOOR SPORTS AND IN-DOOR PASTIMES. Our instructions, if carefully studied, will enable any boy to acquire for himself a practical knowledge of all healthful sports and elevating pastime.

Within the brief limits of a Preface the design of the "Illustrated Boy's Own Treasury" is now revealed to the reader. Studied as a whole—the wide variety of its subjects—the happy, interesting style of their treatment—and the numerous beautiful engravings adorning it—justify the hope that we have produced a volume which the friends of youth may fearlessly present to a boy, and one that the boy cannot study without being interested, as well as made wiser and better for the companionship.

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The Illustrated Boy's Own Treasury of Constructive Wonders.

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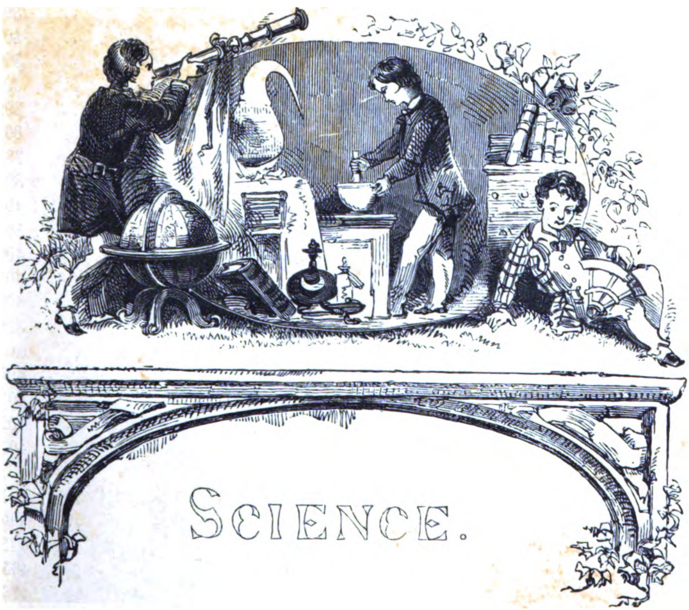
The Illustrated Boy's Own Treasury of Out-door Sports and Recreations.

The Illustrated Boy's Own Treasury of In-Door Pastime and Amusements.

THE ILLUSTRATED BOYS' OWN TREASURY OF



THE STEAM-ENGINE.

WHEN you see the teakettle steaming away upon the fire, we dare say you have never thought much about it, except that you have rejoiced to hear Black Sukey sing so loudly, and warning you that tea is ready. But you will be astonished to hear that the teakettle can show you the first principle of the steam-engine. What is it that puffs out of the spout, and round the cover? "Steam," you will answer, and, perhaps, laugh at the question, because every one knows that. Well, you are right; it *is* what is usually called steam: but we must tell you that it is not really steam, it is vapour. It was steam till it entered the air, and then it became vapour, or water divided into a very great number of small particles or drops. You can prove this by holding a cloth in it, for it will wet the cloth; or, if you hold a cold plate in it, you will soon see that it becomes covered with drops of water. This is the first thing you have to learn about steam. Water heated till it boils is turned into steam; when the steam comes into contact with the cold air it becomes vapour; but if it is exposed to something still colder, it becomes water again. You must remember this, or you will not understand what we are now going to tell you.

Water, then, must *boil* in order to be converted into steam; till then it sends out a very little vapour, but not enough to diminish the quantity of water to any perceptible degree; but as soon as ever the heat is so great that a thermometer held in it rises to 212° it is said to boil, and, from that moment, it begins to pass off into steam; and if the kettle is kept on the fire, *all* the water will pass off in this manner, or "boil away," as it is usually called. But we must now tell you, that when water is in the form of steam it expands, as it is termed; that is, it takes up a great deal more room than it did before. We could tell you exactly how much it expands, if we thought you could understand; but as we wish to make this lecture as easy as possible, we will not puzzle you with this at present. Now you will see why the lid of the kettle appears to want to come off when the water is boiling, and keeps rising and shaking whilst the steam puffs out round it. It is because the kettle cannot hold all the steam that is created within it; the steam, therefore, escapes as fast as it can, and lifts the lid to get out into the air. Now, can you guess what would happen if we were to stop up the spout and fasten down the lid, still keeping the kettle on the fire? We will tell you. The steam inside would go on increasing, and press harder and harder against the sides and top of the kettle till they burst. This will give you some idea of the great power of steam, when it is confined in a close vessel, and cannot escape. In this way even the thickest iron vessels could be blown to pieces; and one of those clever men, who first thought of making use of this great power of steam, used to fill pieces of cannon with water, and then stopping up the end and the touch-hole, burst them by putting them on the fire.

This would be very foolish now, and you need not try any experiments of the kind, as it would be very dangerous; but the man I have told you of wished to see how much power could be obtained by steam, that he might contrive to turn it into some use; and, therefore, *his* experiments were so far from being foolish that he deserves our gratitude for going into all this danger for the good of others. The name of this individual to whom we are so much indebted was Papin, and we will now see how this great power of steam, which he discovered, is made use of. In the diagram, Fig. 1, is represented a boiler of simple construction, made of plates of iron or copper, rivetted very strongly together. It is a large vessel fixed in brickwork, with a furnace underneath; and the first of all, we will suppose it to have a cover fitting tightly into the hole at the top. We have put letters on the different parts that you may understand us better. A B is the boiler, C is the brickwork, D the fireplace, E the ash-pit below. Now, if we take off the cover, we can pour water into the boiler at the top, and half fill it. The lines at B show how the water would appear if you could see into the boiler; then, by means of the fire, we can convert this water into steam, so as to fill the space above, marked A; and if we put on the cover, the steam will soon increase, and press with great force on the inside of the boiler. We will now remove the cover, and put a tube in its place, with a cork pushed into it nearly to the bottom, but not very tightly fitted to it. This we must fix into the top of the boiler, so that the steam cannot escape round it; thus A is the top of the boiler full of steam, B is the tube, *c* the cork, Fig. 2. The steam, you see, cannot escape, unless it can, by pressing against the cork, push it out of the

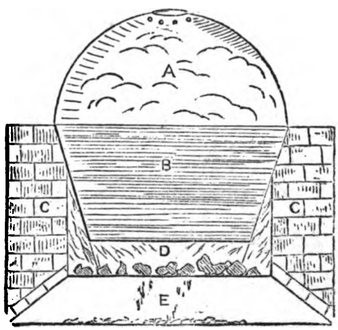


Fig. 1.

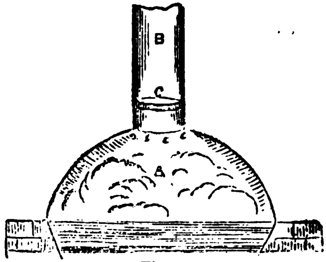


Fig. 2.

tube; but, as we have not made it to fit too tightly, it will very *soon* be pushed up in the tube, and allow the steam more room. But supposing we were suddenly to put out the fire when the cork was nearly pushed to the top of the tube, and pour cold water upon the apparatus, the steam would be cooled, and it would become water again, and require no more room it did at first; and thus it would cease to press against the cork. Now I dare say you would suppose that the cork would remain where it had been pushed to, but it would not; it would immediately sink down to the bottom of the tube, exactly where it had been placed in the first instance.

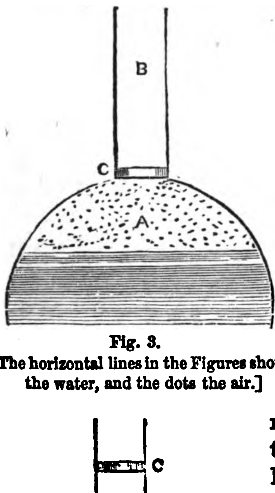


Fig. 3.

[The horizontal lines in the Figures show the water, and the dots the air.]

We will explain to you. Fig. 3 represents our apparatus as it was at first, before the water was converted into steam by the heat of the fire. You see that there is a space between the surface of the water and the bottom of the cork; this space is filled with air, and there is room enough for the air and nothing else. To make it easier, we will not puzzle you with telling you of the expansion this air undergoes, when it is heated, but you may suppose it to remain exactly the same in quantity and size, throughout our experiment. When steam rises from the boiler, it makes room for itself as well as the air, by raising the cork to the top of the cylinder; but having now again got rid of the steam, while the cork is in that position, you will at once see, by referring to Fig. 4, that there is a space between the air and the cork quite unoccupied, and, therefore, the air outside the cylinder will press upon the cork, which is unsupported, and force it back to the same position which it occupied at first. You will be able to understand this by referring to the diagrams. We have assumed here that the

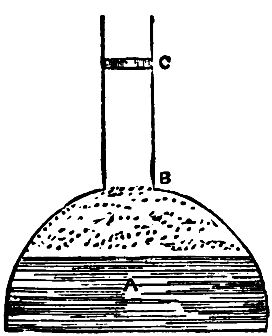


Fig. 4.

air always occupies the same space, because it made this part of our lecture easier. We will now tell you a fact about the air in the top of the boiler. If we heat the air it will expand, or increase in bulk, though the quantity remains the same; and if we afterwards cool it, it will return to the exact size it was at first. We can show you how the same thing can expand or contract without its quantity being increased, by a common sponge. When it is dry it is very much smaller than when wet. When you put a new one in water for the first time, you see it expand or grow larger, but if you dry it, it becomes as small as it was at first; just so it is with the air, only this is heated and cooled, instead of being wetted and dried.

But there is another thing about air which we must remind you of, which is this: if a vessel is filled with it in its common state, as may be done at any time by merely opening the vessel to admit it, it will remain just as it is, so long as the heat is the same; but if we can by any means take away some of it, the vessel will not be partly full only, but quite full, as it was before. This is what we wish to understand, as it is very curious. Look at the diagrams (Figs. 5 and 6.) The first represents a box or vessel filled with air. The particles of air are represented by the globes drawn in it. There are, you see, a great many of these little globes or globules, and they are all small, and together fill the vessel. Now look at Fig. 6. It represents the same box, after we have taken away some of the air; there are now fewer of these globules, because we have removed some of them, yet the box is still quite full. The air left has expanded, and its particles grown larger and thinner. Thus you see that heat expands water by converting it into steam, and it expands air by increasing the size of the particles; and you also see that if some of the air in a vessel is removed, the remainder will immediately expand to fill up the space. When, therefore, the cork is at the top of the tube, there is not really a vacant place between the air and water, as we at first supposed, because the air in the top of the boiler will expand to fill it (for you will observe that it is just the same as if we had filled the boiler and tube with air, and then taken away that which was between B and C).

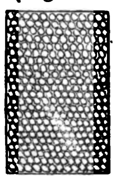


Fig. 5.

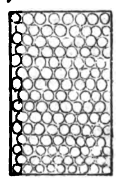


Fig 6.

Now some of you say, that if there is air in the whole space below the cork, it will *not* return to the bottom of the tube, as we said at first; but it *will*, for the air above it is thicker and heavier than that which is now below it, and, therefore, presses upon it with greater force; but it will not push it down *lower* than it was at first, because when it has arrived there, the air above and below it will be exactly equal in thickness, or density, as it is called, and so the cork being pressed upwards and downwards with equal force, will now remain at rest, and the apparatus will be in all respects in the same state as it was when we began.

And now we have done with what we are afraid some of our young friends have thought "a dry beginning;" but there is an old saying and a true one, "that you must walk before you can run;" and if we had left out all this introductory part, you could not have understood the rest. Hoping you have attended closely to what we have been telling you, we will go on now to show you how the principles you have learnt applied; in fact, we are going to show you how the first steam engine was made. Here is a picture of it in its simplest form, and it was used to pump water. The name of its inventor was Thomas Newcomen, either an ironmonger or a blacksmith, who lived at Dartmouth in Devonshire.

A is a tube bored very smooth on the inside, and fitted into the top of the boiler, B, as in our last experiment. We will, however, now begin to call it by another name. It is termed the cylinder of the engine; its lower end is made smaller, and has a stopcock inserted in it. You do not, perhaps, know exactly how a stopcock is made, although you often see them used in water or beer-barrels. The diagram represents one taken apart, and put together. You see that it consists of two parts. A is a plug of wood or metal with a hole cut through it; this fits into a tube, B, and though made to fit it very closely, can be turned round by its cross handle. When, therefore, it is turned so that its hole is in the same direction as the hollow tube, anything may be passed through it, as steam, water, or air; but when the plug is turned so that the hole is against the side of the tube, the tube will be stopped and nothing can pass through it. One of these stopcocks, then, is placed at the bottom of the cylinder, so that by turning it, we can allow the steam to pass through it from the boiler into the cylinder, or prevent it from doing so. In this cylinder is placed what is called a piston, which is, in fact, very like the cork we placed in the tube in our first apparatus, and it will move up and down in the tube just as the cork did. It is not, however, really a cork, but a round piece of metal, made to fit the cylinder by having tow wound round its edge, exactly like the piston

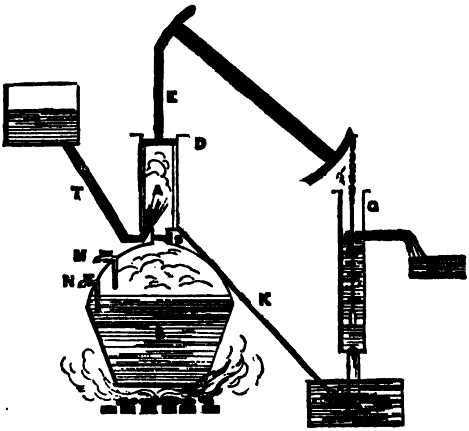


Fig. 7.

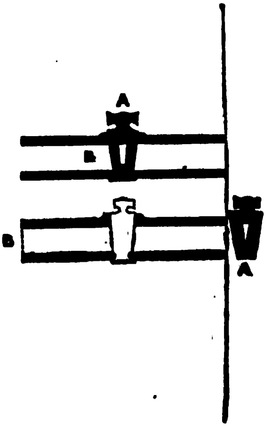


Fig. 8.

that you have seen in a syringe or common squirt. To this is attached a metal rod, E, called the piston-rod. F, is a beam turning upon a fixed centre, like the beam of a pair of scales. The ends you will perceive have an arched piece attached, to the highest point of which a chain is attached, made like the chain in the inside of a watch. To one of these chains the piston-rod is attached, and to the other the pump-rod.

Thus you perceive that if we can contrive to work one end of the beam up and down, the other will also move, but in the contrary direction. We will, therefore, show you how the end to which the piston-rod is attached is alternately moved in this way, by which movement the pump G is worked, and the water pumped out of the well, H. The boiler is half-filled with water, as before, and the cock, S, is closed till the steam raised by the fire, C, presses with some force against the top and sides of the boiler. The tap, S, is then turned, and the piston, which was at the bottom of the cylinder, is raised by the steam below it. This will not *push up* the end of the beam to which the piston-rod is attached, the latter being only united to it by the chain; but the other end of the beam being weighted so as to be the heaviest, will now preponderate, and the pump-rod will be lowered. The piston being now near the top of the cylinder, the steam-cock is shut, and the cold-water cock, T, opened; the cold water from the cistern, L, will now spirt into the cylinder, and turn the steam into water again, or, as it is termed, condense it; and this water will pass off by the pipe, K, into the well, H, or elsewhere. The cock, T, is then stopped, and, there being now no steam or air below the piston, it will descend with great force, being pressed down by the air above it. This alternate opening and shutting of the cocks, S and T, will, therefore, be all that is needed to keep the engine at work. The gratest force being required in the downward stroke of the piston (because the power is needed to *raise* the pump-rod and bucket), and this being effected by the pressure of the atmosphere acting *on* the piston whilst there is a vacuum *below* it, this kind is called an *atmospheric engine.* That the quantity of water and steam in the boiler may be known at pleasure, there are two short pipes, M and N, inserted in it, the end of one just dipping into the water, the other a little above it; thus if steam issues from both, on turning the taps, there is too little water, and if water flows from both, there is too much; but if steam issues from the upper one, and water from the lower, the water is at the proper level.

Now we have got our engine to work, so far as pumping water is concerned; but we hear you remark, that this is a very clumsy and unsightly machine, working slowly and unevenly, and not at all like the pretty engines you have seen, looking so clean and bright, in a jacket of green paint, with bright steel glittering here and there. But look at this egg? how unlike the beautiful green and gold kingfisher sporting in the stream! Yet the principle of the future bird is there, and, by slow degrees, the bird will spring from it; but it will be long ere the brightest feathers deck its form. So with our engine; it is but the bird newly hatched; it has neither arrived at its full strength of symmetry, and requires yet a great many improvements. First, it requires to be very closely watched; for it cannot make a single stroke till the cock-boy has done his office of admitting steam and cold water alternately. The first improvement was to make the engine do this work for itself. A boy was the inventor of this new movement—an idle boy, named Humphrey Potter; for, wishing to go and play, he tied the levers of the cocks to the beam and to each other, and thus made the beam, in its alternate motion, open and shut them. This was afterwards improved in various ways; but the greatest improvement was the removal of the stopcocks and levers, and the introduction of slide valves. Before this was introduced, however, the engine was very much altered; the cold water was no longer admitted to the cylinder, but the condensation was carried on in a separate vessel, by which the cylinder was kept hot. This was a great point gained, for when the steam in the old engine was first admitted to drive up the piston, part of it was condensed by the cold cylinder, and this condensation continued till the cylinder was heated to the temperature of the steam, and then only the piston began to ascend. This was the invention of James Watt, to whom all the other improvements we shall mention are also due. You have observed that as yet the power of the up-and-down stroke in the atmospheric engine is very different; and although this was of little consequence in pumping water, it would be a serious drawback in the application of steam-power to driving machinery. Watt, therefore, proposed to use the force of steam both in the up and down stroke, and in turn condensed the steam from each end of the cylinder. For this purpose he fitted a cover to the cylinder through which the piston removed, air and steam tight. The mechanism by which the steam was alternately admitted above and below the piston was at first rather complicated; but it is now very simple, and we will, therefore, explain it to you. C is the cylinder, with its cover, A, through which the piston-rod works steam tight; the openings for the steam are at the side, and are marked *o*; these are connected with a cylinder or tube, *b*, closed in the same manner as the large cylinder. In this another tube, *d*, works up and down, steam tight at the parts *d' d'*, but leaving a space round it between these points. The rod, *e*, is worked up and down by the engine, and by it the tube is made to occupy one of the three positions of which it is capable. If you look at the diagram, you will easily understand this, although we have only

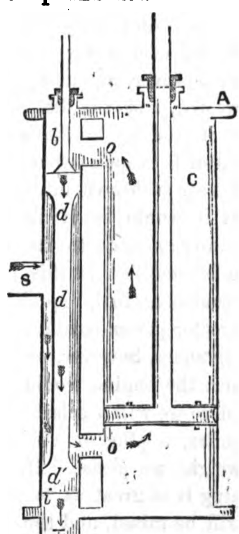
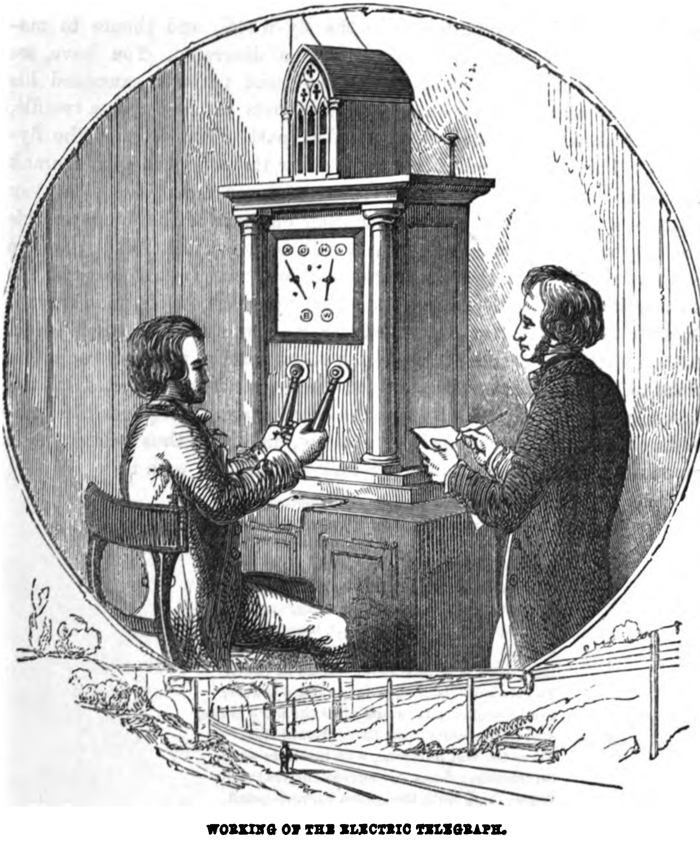


Fig. 9.

drawn it in the position it occupies when the piston is at the bottom of the cylinder. Steam being admitted from the boiler by the pipe, S, will flow round the inner tube, and enter the cylinder in the direction of the arrows, and thus raise the piston; at the same time the air or steam above the piston will pass *down* this inner tube, *d*, into the condenser by means of the pipe, T, leading to it. Now, suppose the piston arrived at the top of the cylinder, the tube is drawn up till the steam-tight parts are respectively above the parts *o o*—(you can draw it in this new position for yourselves); then you will see that the steam can enter at the top of the cylinder, and force the piston down again, whilst the steam below is free to pass to the condenser by T, as before. When the tube is in the third position, the steam-tight parts will cover both the openings *o o*, and the steam being thus prevented from entering the cylinder, the engine will be at rest. We must now tell you what the condenser is. It is merely a vessel of cold water, into which the waste steam is admitted; but this water would soon become hot, and condense no longer. There is, therefore, a pump attached to it, and worked by the engine, which draws off the water by degrees, whilst cold water is continually admitted to supply its place. There is, however, a plan by which this warm water is prevented from being wasted, and it is this: the pump which draws it off has a pipe attached to it leading to the boiler, and just in proportion as the water in the latter is evaporated a fresh supply of this heated water from the condenser is thrown into it, and thus the water in the boiler is not cooled, as it would be if the injected water were cold. The various other additions made to the steam-engine from time to time are too numerous to be specified in this brief lecture. Their object has chiefly been to economize fuel, equalize the working of the engine, and to secure greater power combined with greater safety. One or two of the contrivances, however, we must describe, as they are of great importance, and the engine would be very incomplete without them. The safety-valve we will explain first. An opening being made in the top of the boiler, a plug or valve, is fitted to it; this plug is loaded with any weight we please. If, therefore, the pressure of the steam below the plug is so great as to overcome the pressure of these weights, the valve will be raised, and the steam will be able to escape. Thus all risk of bursting the boiler is avoided.

There is but one thing to be mentioned, and that is the way in which motion is communicated to the fly-wheel, and thence to machinery. We can explain this without a diagram. You have, we dare say, often watched a knife-grinder, and perhaps examined his grinding apparatus. You observe that he puts his foot upon a treadle, from which a strap passes to a crooked part of the axis of the fly-wheel. This part is called a crank. Now there is just such a crank upon the axis of the fly-wheel of a steam-engine. If, then, you imagine a rod, or strap, to proceed from one end of the beam to this crank, you will at once see that it will revolve as the beam goes up and down; in fact, the beam and rod only supply the place of the knife-grinder's treadle and strap. This fly-wheel is of great use; it is, as it were, a reservoir of work, for it soon attains a steady equal motion; and if it should happen that at certain times there is less work to be done, the extra power of the engine is accumulated in, and taken up by, the fly-wheel; and the momentum it acquires also prevents the engine from stopping suddenly, and it is thus calculated to give an uniform motion to the machinery connected with it.

The giant power, from earth's remotest caves,
Lifts with strong arm her dark reluctant waves;
Each cavern'd rock, and hidden den explores,
Drags her dark coals, and digs her shining ores:
Next in close cells of ribbed oak confined,
Gale after gale, he crowds the struggling wind;
The imprison'd storms through brazen nostrils roar,
Fan the white flame, and fuse the sparkling ore.
Here, high in air, the rising stream he pours,
To clay-built cisterns, or to lead-lined towers;
Fresh through a thousand pipes the wave distils,
And thirsty cities drink th' exuberant rills:
There the vast millstone, with inebriate whirl,
On trembling floors, his forceful fingers twirl,
Whose flinty teeth the golden harvests grind,
Feast without blood, and nourish human kind.
Now his hard hands on Mona's rifted crest,
Bosom'd in rock, her azure ores arrest;
With iron lips, his rapid rollers seize
The lengthening bars, in thin expansion squeeze;
Descending screws, with ponderous fly-wheels wound
The tawny plates, the new medallions round;
Hard dies of steel the capeous circles cramp,
And with quick fall his massy hammers stamp,
The harp, the lily, and the lion join,
And George and Britain guard the sterling coin.



WORKING OF THE ELECTRIC TELEGRAPH.

THE ELECTRIC TELEGRAPH.

THE application of electricity to the conveyance of messages is now so general, not only in our delightful little island, but on the Continent, that we are anxious our boys should know something of the principles and means whereby this is effected. In the description of the Electric Telegraph, therefore, we will lay aside all technical and scientific terms, and explain clearly this great wonder of our day The source of the electricity used requires our first attention. This is what is called a voltaic or galvanic battery; and it is so called from Volta and Galvani, its originators. We can make a very simple battery by means of two tumblers, a little salts and water, two small pieces of zinc, and two of copper, united in the following manner:—A and B are the tumblers, *c c* the pieces of copper, *z z* the pieces of zinc; the tumblers being partly filled with the salt and water, the battery is complete. You will observe that the metals used are dissimilar; that a plate of copper and one of zinc unite at *e*, and that there are wires fixed to the other two plates, which as yet are in no way connected. Whilst things are in this state, nothing will take place; the battery is at rest, and no electricity is evolved by it; but, if we join the two wires, a current of electricity will immediately pass, and this current will continue till we again separate the wires. You will naturally ask the reason of this; but we may tell you that it is not known. We might enter into what some may call an explanation of it; but, after puzzling you with all kinds of technicalities and scientific terms, you would be none the wiser, and we should but return to where we began. Yet, if we cannot explain the cause, we can give you a general idea of the effect, and point out this simple rule:—If two plates of metal are placed in a solution which will only dissolve one of them, and their upper edges are brought into contact, whilst the others are kept apart, a current will pass from one to the other through the solution, and passing also from one to the other at the point of contact, will continue thus circulating, till either the soluble matter is consumed, or the liquid itself is saturated—that is, has dissolved as much metal as it is capable of dissolving. This is always the case; but often the effect is so slight that it is rarely perceptible. Take a piece of silver and a piece of zinc the size of half-a-crown, place one upon the tip of the tongue, the other under it, bring their edges into contact, and what is called a shock will be perceptible; that is, the saliva acting upon the zinc, and not upon the silver, a small battery is made, and the electricity passes from the zinc through the tongue to the silver, thence to the zinc again, and thus circulates till you part the

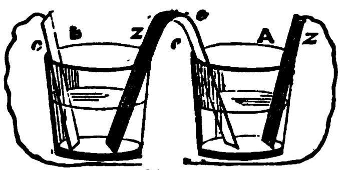


Fig. 1.

edges of the metals. The shock is very slight, being chiefly known by an acid taste; nor would it be felt at all, but that the tongue is so acutely sensitive. We have called this a small battery, but it is scarcely a correct term; it is a single voltaic pair—a battery, in its proper sense, being made up by a union of two or more such pairs, as in the case of the one above. In practice, a battery consists of twelve or more such pairs; and the following sketch represents one, commonly used in

Fig. 2.

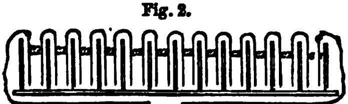


Fig. 3.

working the electric telegraph. It contains twenty-four pairs of zinc and copper plates, about four inches square. Each pair are soldered together by means of a strap of metal, as in Fig. 3. To make it quite clear, we have drawn but twelve pairs in section, and lettered the alternate plates, *z* standing for zinc, and *c* for copper. The trough in which they are placed is either made of baked wood, glass, earthenware, or gutta-percha; the only requisite being that it is a non-conductor of electricity—that is, such a substance as electricity will not readily pass through. The last plate at one end is zinc, and the other copper, and a wire is soldered to each. If these wires are joined, a current of electricity will pass from the zinc plate to which one is attached, through the exciting liquid, which is here sulphuric acid and water, to the copper plate in the same cell, thence by the metal strap to the zinc of the next cell, and thus through the whole series to the other single plate, whence it passes by the wires to the first zinc plate again. But as each pair of plates produce similar currents, their combined power is very great, and a large quantity of electricity passes through the terminal wires. So much for the battery. We will now go a step further, and learn an extraordinary effect which it is capable of producing. You know what a magnet is, and many of you have, we dare say, seen a mariner's compass—if not, we must briefly tell you what it is. It consists of a flat piece of steel, of this shape, which is called a needle. This

is suspended on a point, by means of a small hole, or rather conical indentation made in its centre. This needle being magnetised, and thus suspended, will always point in the same direction, one end being directed to the north, the other to the south; and it thus enables the sailor to go in any direction he may desire. For if he knows where these points are, he can tell the east and west; and if, as is always done, a card is placed below the needle, with the intermediate points carefully marked upon it, he has no difficulty in steering exactly to any place of which he knows the position; and thus the compass is to the sailor on the pathless deep just what the direction-post is to the traveller. Now, if we take such a needle as we have described, and suspend it vertically on an axis passing through its centre, and then, by means of a wire, pass a current from our battery round it thus, the needle will take up a new position at right angles to that which it maintained before, indicated by the dotted lines. Whether the upper point or north pole of the needle moves to the right or left in order to attain this position, depends on the direction of the current. Thus we have arrived at the principle of an electric telegraph. We have but to agree upon a set of signals, that the deflection of the needle shall signify: and if we can contrive to send the current in the direction we wish, so as to move the north pole of the needle to the right or left at will, the apparatus will be complete. But, in practice, it is necessary that we should be able to move as we please, a similar needle to our own, at the station to which we desire to send the message. In order to accomplish this, we have but to conduct the current from one station to the other by means of an insulated wire. This will be easily understood by the following diagram, where the battery is represented at A, and the different stations at B, at each of which the needles have their north poles upwards; and the wire conveying the current passes n the same direction round all, and lastly returns to the other pole of the battery; thus the current, leaving the battery by the copper or positive end *c*, will traverse the wire in the direction of the arrows, deflect the needles in the same direction at the different stations, and return to the zinc or negative end of the battery by the same wire.

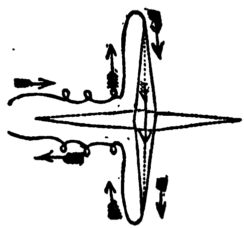


Fig. 5.

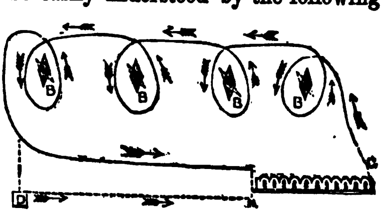


Fig. 6.

We will now tell you a very curious fact about the return of the current. The *return wire* is not necessary, nor is it now put in practice; for a man named Sternheil proved, in 1837, that if we buried deep in the ground the end of the wire, attaching it to a plate of metal, the earth itself would conduct the current back again, thus saving the cost of a return wire. Thus, in the figure above, we have represented this by dotted lines, and marked the direction of the return current by double arrows, N O being the plates of metal, and having the wires attached to them.

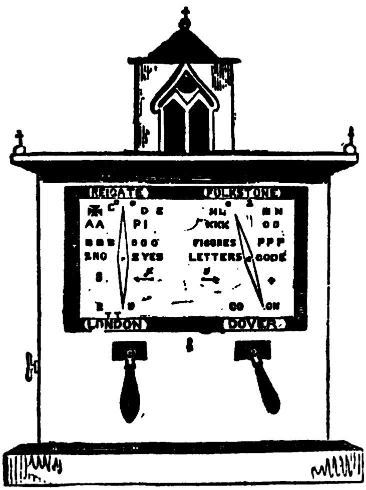


Fig. 7.

I must now try and explain the instrument by which communication is made with the battery, and which is qualified not only to send, but also to receive signals. It is represented below—Figure 7 being the exterior, and Figure 8 the interior. The needles in Figure 7 (for there are usually two), are on the same axis as the ones on which the electric current acts, only their poles are reversed—the north pole of the one being opposite the south pole of the other, by which the effect of the earth's magnetism is annulled, and they are the more powerfully influenced by the electric current. It is by means of these outer needles that the signals are read: they are prevented from deflecting too far from their vertical or upright position by two ivory studs, one on each side; and thus the signalling is rendered more certain and rapid than if they were allowed to oscillate further. The handles at the lower part of the instrument are for moving the barrel in the interior, the one at the side for ringing a signal bell, which is also effected by electricity.

In Figure 8, we are looking at the back of the instrument, the case being removed. B, is the coil of wire for passing a current of electricity round a magnetic needle suspended in it by its axis. In the former drawing, the wire passes but once round the needle; but by winding it round several times, as here shown, the effect is greatly increased. W W are the wires which transmit the current to and from the distant station. We will now see, first, how the instrument is calculated to *receive* signals. C is a cylinder of boxwood, capped at each end with brass; D, F, H, O, are slips of metal, the shape of which is seen clearly on the left side of the barrel; a piece of wood, K, projects from the front of the case, having a metal bar about an inch in length inserted through the end, standing across it, as in the figure. Now, if W W″ are connected at the distant station with the two poles of a battery, a current will pass along one of these wires, W, and along the slip of metal, O, to the coil, B, having, in its passage round this deflected the needle, thereby making a signal; it will descend by *a*, down the slip of metal, *x*, thence to the spring, *e* (which is a part of the same slip), through the metal bar to *e*, and thence by F to W″, and to the other pole of the battery. We have told you that this return wire, W″, is not used in practice; nor is it; but, by supposing it to exist here, the direction of the current is more easily understood. We have, by the dotted lines, shown the buried plate attached to this wire. You should look well at the figure, and read this description of receiving signals several times, till you see it clearly; for though, at first sight, the apparatus appears very complicated, it is not so; these slips of brass, so curiously shaped, being all that is required to *receive* signals; to *send* them, the cylinder C is added, the action of which we will now explain. The furthest end of it is joined to one of the handles seen in Fig. 7, by which it is made to revolve in either direction. Supposing, then, we move this handle so as to cause the small metal pin *z* to press against the spring *e*, we can thus remove the end of this spring from the short bar against which it rested, whilst the pin *y*, at the other end of the cylinder, will touch the curved end of the slip F (both these pins are fixed into the metal caps at the ends of the cylinder). The current will now pass from the battery by the spring H to the brass cap of the cylinder, thence by the pin *z* to *e*:

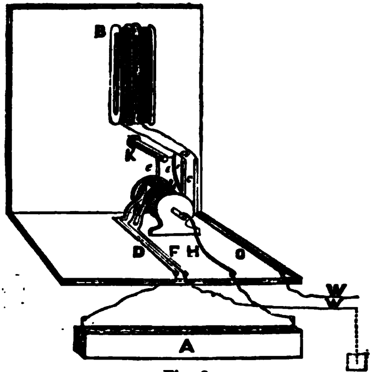


Fig. 8.

t being removed from the short bar, and the current thus cut off in that direction, it will pass to *x*, which is a part of the same slip as *t*, thence round the coil deflecting the needle, and passing to the next station by the slip *o*, and wire W will deflect the needle there, and return by the earth-current to W!′. Although it is a crooked path, the electric current traverses it so quickly that no perceptible time elapses between the movement of the needle at our own instrument and the various needles of all the telegraphs on the line. Each handle has a separate cylinder, and each needle a separate coil, one only being represented for the sake of clearness. Every word of the message sent is spelt letter by letter, according to the number of times that each needle moves. The following is one of the usual alphabets, and (as in Fig. 7) this is commonly inscribed on the face of the instrument. It is the code of a single needle :—

A—One movement to the left.
B—Two left.
C—Three left.
D—Four left.
E—One left, one right.
F—One left, two right.
G—One left, three right.
H—Two left, one right.
I—Two left, two right.
J—Two left, three right.
K—Three left, one right.
L—Three left, two right.
M—Four left, one right.

N—One right.
O—Two right.
P—Three right.
Q—Four right.
R—One right, one left.
S—Two right, one left.
T—Three right, one left.
U—One right, two left.
V—Two right, two left.
W—Three right, two left.
X—One right, three left.
Y—Two right, three left.
Z—One right, four left.

With two needles the alphabet is somewhat different; but you will now understand how the movement of the needles can signify words; and we think you must now have a very good idea of the machinery of an electric telegraph. We shall now show you how the alarum is rung by electricity, to give the clerk at the instrument notice that a message is about to be sent to him, that he may be at his post, and ready to watch the needles, and read.

Wonderful as it may appear, an electric current passing round a piece of soft iron will instantly convert it into a magnet; but its magnetic properties cease as soon as the current stops. In the telegraph alarum this effect of electricity is thus applied:—A is a piece of soft iron bent into the form of a horse-shoe; some covered copper wire is wound round it, the ends B and C being left loose for the purpose of connecting them with the battery. D is a piece of steel, connected with the lever, E; the other end of which forms a detent or catch, which falls into one of the notches in the wheel, F. This wheel, when the catch is removed, will revolve by a spring, and, like the movement in a common clock, acts on the hammer, H, which strikes the bell, G. B and C are connected with the distant station by a wire, as the needle apparatus. When the operator, therefore, at

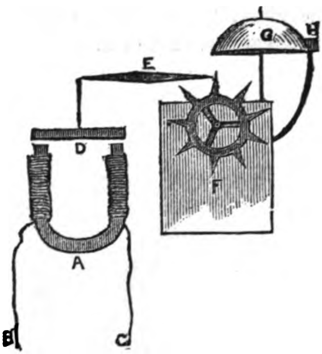


Fig. 9.

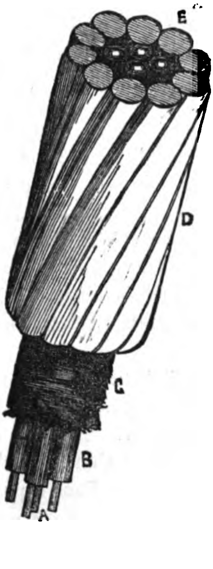
that station, sends a current from his battery along this wire, A will become a magnet, and attract the keeper, D; this, by means of the levers, will release the wheel, F, and the clock-work will cause the hammer to strike the bell. This will call the attention of the operator, who will return the signal, and watch the movement of the needles, read the message, and send the reply in the same manner.

This is the whole mechanism of the electric telegraph, which is certainly the grandest of all modern inventions. It has been continually improved, in various ways, since it was first invented, by different scientific individuals; and there are several differently-constructed instruments in use on the different lines of railway. The wires which connect the different instruments are, in England, supported on posts, having small rings of earthenware attached to them, through which they pass. These wires are covered with zinc, and every precaution is taken to insulate them, that the electric current may not escape into the earth on its passage. On the Continent, and in the streets of London, the posts are done away with, and the wires, cased in gutta-percha, are buried in the earth. The Electric Telegraph is certainly a triumph of art and shows us how much may be done by the united labours of scientific men; and we may remind our young readers that, before such great works can be accomplished, the most unwearied diligence and patience must be exercised. Days and years of study, with resolution to overcome every drawback and difficulty, can alone lead to such valuable results; and if our young friends would share the glory, they must also take part in, and imitate, the diligence of the great inventors of these modern wonders.

THE SUBMARINE TELEGRAPH.

If all the myths of the old poets were realized to-morrow, not one of them would stand a chance with the hard practical realities of the electric telegraph. The boldest story-teller of Rome or Greece never dreamt of annihilating time and space, even for the express purpose of making two lovers happy; and the most extravagant metamorphose ever imagined by Ovid might have been readily believed a century ago by the sternest philosopher of the age, if he could first have been made to swallow and accredit the prophecy that his descendants could walk down to Cornhill and receive a reply to a message to Paris in a minute. The celebrated Hibernian bird which contrived to exist in the flesh in two places at once, must have encountered difficulties to which the magnetic current is a stranger; and, except that ornithological phenomenon, of which no specimens at present exist, there is certainly, in art, in nature, nothing more wonderful than this mastery, which man, by the aid of a few plates of metal, some acid and wire, has obtained over the subtle fluid, the effects of which are as patent and striking as its source is mysterious. The electric flash, the type of all that is swift and destructive in the elements, is here chained to the car of commerce, or wielded by curiosity or caprice. The message flies "ere one can say 'it lightens.'" The electric fire is bottled up in little wooden cases with brass knockers and screws, or is served out at will from oblong jars under the counter, moulding itself into the inflections of every language, and adapting itself to the exigencies of every thought, and beating that old, but remarkably fast person, Old Time, hollow, whenever the race is long enough. There are some dissatisfied people who wish they had been born a little later; they want to see the full development, they say, of the twin giants, steam and electricity; to listen to the first announcement of the great discoverer who shall pierce the darkness that hangs over the birth-place of those family connections whose exact relationship they as yet know not, and proclaim the parentage of Light and Heat, and lightning in its varied forms. It is privilege enough for us to live in an age when, science having ceased to be empirical and impious, devotes itself to the practical wants of man, and, astonished at its success, confesses still how little it knows of its future, without our grudging to those who may come after, the fruits of its more matured enterprise and experiment.

The project of constructing a submarine telegraph between England and France, across the Strait of Dover, unsuccessfully attempted in 1850, was again undertaken, and accomplished in 1851. The line or cable at present in use is much more substantial than that formerly employed, and was constructed in the following manner:—Four copper wires, known as the 16 wire gauge, each encased in a covering of gutta-percha, of a quarter of an inch in diameter, constituted the first layer. These several lines are twisted and plaited about each other, in spiral convolutions, in the manner of an ordinary cable or rope. The next superincumbent coil to this consisted of hempen yarn, previously saturated in a reservoir of prepared pitch and tallow, and, in its turn, is tightly twisted and compressed, impermeably and by steam power, over the gutta-percha, with its enclosed copper wires. This is overlaid again with a series of hempen yarns, five or six in number, and about an inch in diameter, saturated in the pitch and tallow, with a view of what the workmen call "worming" the gutta-percha. The gutta-percha thus protects the wire, and the hempen yarn in addition acts as a cementitious material to the gutta-percha, which, ultimately, has thrown over it a coat of galvanized wire. This completes the first process, and the manufacture of the rope in the spiral form is for the purpose of giving flexibility. The second process consists in hauling off the cable, so far completed, and passing it on to another wire-rope machine, where the cord is completely covered over with ten galvanized iron wires, each wire being about the thickness of a lead pencil, and known as "No. 1 galvanized wire guage." This



galvanized iron sheathing is to protect and preserve the interior layers from the action of the sea, and the weight is considered to be sufficient to sink the cable *ex necessitate gravitatis*. The accompanying engraving will explain to the reader this curious process. A, the four conducting copper wires. B, covering of gutta-percha. The double covering of gutta-percha is more clearly explained by the section E. C, spun yarn, saturated with tar, wound round the covered wires, and filling up the interstices so as form a core upon which the galvanized wires are laid. D, outer protection, consisting of ten galvanized iron wires. E, section of the cable complete. The appearance of the cable, thus completely encased in a shining coat of galvanized iron, and divested of tar and dirt, is quite lustrous and silvery. The entire weight of the cable thus completed was about 200 tons. The actual submersion of the great cable took place on the 25th of October, 1851. Our first engraving represents the process adopted for submerging the coil. The huge coils were arranged on board Her Majesty's ship *Blazer*, towed by the steam-ship *Fearless*. One end of the cable being secured to the beach, on the South Foreland coast, the *Fearless* then steamed ahead—having made fast her towing tackle to the hull of the *Blazer*—at the rate of two miles an hour out to sea, the men on board the latter vessel paying out continuously the cable over her stern, from whence, by the action of its own weight, it sank into the submarine sand and valley.

The success of the telegraph between England and France has induced further attempts in numerous other directions—by far the greatest, however, has been the laying of the Atlantic cable, the wonder of the age. Indeed, the day seems near at hand when the submarine telegraph will span, from shore to shore, every sea and ocean over which it may be desirable to transmit any message affecting the well-being of the human race, or concerning the individual interests of man.

GALVANISM.

Galvanism is so intimately connected with electricity, that it may be considered as a branch of that science. It was first accidentally discovered in the chemical laboratory of M. Lewis Galvani, professor of anatomy in the university of Bologna, upon the following occasion: The lady of the professor being of a delicate habit, was occasionally supported by soup made from frogs as a restorative. Some of these animals, skinned for that purpose, were lying upon a table in the laboratory of the professor, in which stood an electrical machine. One of the assistants, in experiment, by accident brought the point of the scalpel near the crural nerves of a frog recently killed, lying not far from the conductor; the muscles of the limb were instantly set in motion, being agitated with strong convulsions.

Hitherto this influence or agent had been chiefly investigated with reference to its operation on animal substances. Hence its popular name was for a long time, *Animal Electricity:* but it being soon found that its agency was more extensive; that it possessed powers not indicated by this denomination, and that of course the retention of this name would lead to error, the word *Galvanism* was adopted in its stead.

The simplest galvanic apparatus consists of a set of tumblers, containing water slightly mixed with nitric or sulphuric acid, which are connected by bent wires with a piece of zinc at one end, and a piece of copper at the other; connect the tumblers by placing these in them all in the same order—one metal in the first and last, and both metals in each intermediate one:—touching the first copper and the last zinc with the fingers will occasion a shock.

The pile is made thus: Take twenty or thirty pieces of zinc, each as large as a penny. Get as many pieces of copper about the same size, and also as many pieces of paper or cloth, which are to be dipped in a solution of salt and water. In building up the pile, place zinc, paper, copper, &c., constantly in the same order until the whole be finished. The sides of the pile may be supported with rods of glass, or varnished wood, fixed in the board on which it stands. The following experiments may then be performed:—

Having wet both hands, touch the lower part of the pile with one hand, and the upper part with the other; a slight shock of electricity will be felt as often as one hand is removed. If the hand be brought back, a similar shock will be felt. Put a basin of water near the pile, and put the left hand into it, holding a wire, the one end of which touches the top of the battery or pile; then put the end of a silver spoon between the lip and the gum, and with the other end of the spoon touch the lower part of the pile; a strong shock is felt in the gum and in the hand. Take the left hand from the water, but still keep hold of the wire, and then perform the last experiment in the same manner, and a shock will be felt in the gum only. Hold a silver spoon in one hand, and touch with it the battery at the lower part, then touch the upper part with the tongue, the bitter taste is extreme. In performing the above experiments, if, instead of the two ends of the pile, the one end and the middle of it be touched, the sensations will not be nearly so strong.

Modern research has considerably augmented our knowledge of Galvanism. It was, after some time, discovered that the efficiency of a Galvanic Circle depends on its being formed of three bodies, two of which have a powerful effect on each other, but neither of them, if possible, any on the third. Hence perfectly pure zinc, or (what answers extremely well) zinc amalgated with mercury, platina, and dilute acid; or charcoal, zinc, and acid, form batteries which are very effective, and which from their long-continued actions are called *constant* batteries.

INSTRUCTIONS IN THE ART OF PHOTOGRAPHY.

CHAPTER I.

ADVANTAGES OF THE ART—ITS GENERAL APPLICATION—OUR PLAN OF PROCEEDING—COMPREHENSIVE PLAN OF THE SUBJECT—OUR PHOTOGRAPHIC NOTES AND QUERIES.

By the aid of a sunbeam every person may become an artist, without possessing any knowledge of drawing, and thus all classes are under infinite obligation to this art. The physician is enabled, by its means, to delineate the gradual changes of disease, or pourtray the types of insanity with a faithfulness never before known; and by its aid he can obtain copies of these types for the use of his medical brethren. The architect can copy the most extensive building, with its elaborate details in a few seconds, and, by its aid, benefit by the experience of foreign lands, as well as his own, through the effective agency of the photographic camera. The mechanic is under vast obligations to the art, for by its assistance he is enabled not only to fix the perfect resemblance of the most complicated machinery upon paper; but also to reproduce it, and thus make his distant friends as well acquainted with the details as he is himself. The traveller can preserve faithful memorials of his visits to remarkable places by its assistance; and the archæologist, the botanist, and the numismatist are all under great obligations to the art. The artist can obtain the best studies of perspective, of light and shade, of grouping, position, &c., by its truthful aid. We might extend the list of the advantages of the art to a considerable length, but our space does not permit.

We shall here endeavour to make the principle and practice of photography, in all its branches, clear to our young readers. This will comprise the production of pictures by the action of light, upon prepared surfaces of paper, glass, talc, silvered plates, &c., by the processes commonly known as Photography, Talbotype, or Calotype, Daguerreotype, Anthotype, Cyanotype, Ferrotype, &c., giving all the best and latest improvements in the art.

CHAPTER II.

FASCINATION OF THE ART—DERIVATION OF THE NAME—AGENCY BY WHICH THE PICTURES ARE PRODUCED—NECESSITY FOR UNDERSTANDING THE THEORY OF LIGHT.

1. It is probable that you do not know *anything* about photography, or photogenic drawing as it was formerly called; and even if you know *something*, we have no doubt that you will be desirous of learning more, because the art is one of the most fascinating with which we are acquainted. It is needless to allude to its beauties more particularly, as you will discover fresh charms each day—nay, each hour, minute, or second.

2. Perhaps our boys are frightened at the hard name which the art bears; but if not possessed of its true signification, we will soon enlighten you upon the subject. The word Photography* is derived from two Greek words, *phose*, light, and *grapho*, to write or depict; while the word Photogenic is also derived from two Greek words, *phose*, light, and *ginnomai*, I generate.

3. It therefore appears that the chief agency by which the pictures are formed is light, which has long been known to produce other effects upon objects than their mere illumination, &c.

4. Unless you are acquainted with the nature and properties of light, the agent by which these pictures are produced, it is impossible that you can ever make a scientific photographer. It is true that you may produce pictures, and very good ones, but this is a quackish manner of proceeding; you are literally in every sense of the word working in the dark, although assisted by light.

5. We think that *every person* should understand the nature of light, more particularly those who practice Photography. Indeed, it is absolutely essential that photographers should do so; consequently we shall commence our instructions in the art by treating of the agent—light—by which the wondrous effects are produced, and explain clearly and distinctly the leading points connected with Photography.

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* The word Photography is pronounced thus, Fo-tog-graffy—the accent on the second *o* being pronounced as the *o* in clog, not, cock, collar, con, concave, &c.

CHAPTER III.

LIGHT—ITS SOURCE—NATURE OF THE SUNBEAM—NEWTON'S ANALYSIS OF LIGHT—THE SOLAR OR PRISMATIC SPECTRUM—ITS ARRANGEMENT AND PROPORTIONS—WHITE LIGHT—FORMATION OF THE SPECTRUM—RESOLUTION OF COLOURS.

6. LIGHT—the agent by which we are enabled to depict nature or art with an accuracy that baffles the most experienced artist—is derived from the sun. True it is that there are other sources of light; but photographers have nothing to do with them—they must only confine their attention to solar light, and the chemical changes it produces.

7. You observe the glorious sun, how it pours forth its beams, and yet you know little of the nature of a sunbeam. No doubt, you think that you *do know;* but we question it—nay, are almost certain that you do not. Ah! we were correct. Well, then, to explain:—A solar beam of light is a bundle of rays, each of which possesses distinctive characters, both as regards their chemical functions and colours, which you may very easily prove in some respects at present, but more fully hereafter.

8. We have found that a sunbeam is a compound; at least it has been stated that such is the case; for Sir Isaac Newton proved that the white light emitted from the sun is not so simple as it appears, but is composed of the most vivid colours and tints that can be imagined. However we will examine for ourselves, by performing the beautiful experiment called "Newton's Analysis of Light." [Experiment 1]. You observe that we have a prism (*b c*, Fig 1), or triangular mass of glass, which is so contrived that it may be adjusted to any angle, or placed in any position we may require. This is not absolutely necessary, because the prism may be held in the hand; but as we wish to have both our hands free, we have arranged the apparatus as you observe. We will now close the shutters of the room, and admit a ray of light either by bering a hole in the shutters or separating them a little. The ray of light (*a e*, Fig. 1), is admitted into the darkened room by means of a hole (*a*) in the shutter. You see that the space between the shutter and ourselves is traversed by the sunbeam or ray of light, which appears to cause little particles of dust to dance in the atmosphere of the room. This appearance, however, is due to the illuminating power of the sunbeam contrasting with the other darkened or

non-illuminated space in the room, as it renders the small particles of dust floating in the air visible; but as the surrounding space is not illuminated by the solar light, we cannot distinguish the floating particles of dust; neither can we do so in the same room when *entirely lighted*, because there is no surrounding dark space to contrast with, or form a background, as it were, to the sunbeam. As soon as the prism (*b c*, Fig. 1) is placed in the path of the sunbeam, so as to allow it to fall on one of its angles (*b*), the ray will be refracted, or bent out of its course, so as to pass towards the back of the prism (as in the line *d*), and not in the same line (*a e*) that it would otherwise have done, had not the prism been interposed. There is another effect, however, takes place; for you observe that an elongated delicately-coloured image is formed upon the wall (*d e*); and if you stand at a short distance from the prism you will see that these colours are spread out into a triangular form, the base of which is on the wall, and the apex, or point of origin, at the back (*c*) of the prism. We will remove the prism, and observe what takes place. [Does so]. Now, you see that the splendid display of colours upon the wall has disappeared, and a round spot of white light (*e*) is seen below the place occupied by the solar spectrum.

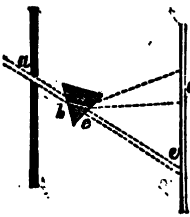

Fig. 1.

9. The coloured image you saw upon the wall is called the *prismatic* or *solar spectrum*, which, according to Sir Isaac Newton, is composed of seven different colours (see Fig. 2). The colour at the lower portion of the image, or that nearest to the round white spot (*e*), which appeared on the wall when the prism was removed, is of a red colour, and the one at the other end is of a violet colour; the whole intermediate parts being occupied by five other colours, and the whole arranged thus:—

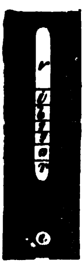

Fig. 2.

Top.
Violet.
Indigo.
Blue.
Green.
Yellow.
Orange.
Red.
Bottom.

10. The red ray is the least, and the violet the most refracted of this chromatic image.* If the spectrum be divided into 360 equal parts, corresponding with the 360 degrees of a circle, the prismatic colours will be found to occupy the following number of parts:—

Violet	80 parts.	Yellow	48 parts.
Indigo	40 „	Orange	27 „
Blue	60 „	Red	45 „
Green	60 „		360 „

Since Newton's time various experiments have been instituted by many philosophers, who have detected other rays; for instance, *a crimson or extreme red ray* has been discovered below the red ray, by examining the solar spectrum through a deep blue glass; and Sir John Herschel observed a *lavender ray*, beyond the violet ray, by throwing the spectrum upon a piece of yellow paper. Mr. Stokes has proved the existence of an extra spectral ray far beyond the violet; but, as we have remarked before, our consideration of light does not extend beyond its practical use to photographers, and, therefore, we do not intend to discuss the science of optics in the full sense, but merely to become familiar with those facts that will prove serviceable to us in our future researches.

11. Sir Isaac Newton was of opinion that white light was composed of seven primary rays, each possessed of a certain degree of refrangibility, or capability of being turned out of its natural course; and he also considered that the colour of a ray indicated its angle of refraction. Sir David Brewster has demonstrated that the seven *primary colours*, as Sir Isaac Newton called the rays of the solar spectrum, are not primary, but that only three of them are so—viz., blue, yellow, and red; the rest are compounds of the three primary colours, which form the spectrum by overlapping each other.

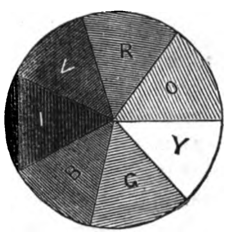

Fig. 3.

* Fraunhofer measured the length of each of these rays with great care; and has stated the following to be the result of his investigations:—

Violet	109	Yellow	27
Indigo	47	Orange	27
Blue	48	Red	56
Green	46		360

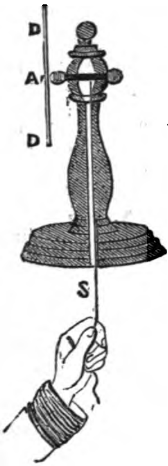

Fig. 4.

12. [Experiment 2]. If we take a disc of card-board (Fig. 3, and D D, Fig. 4), and divide it into seven parts, each of which is painted with one of the colours of the solar spectrum, and affix it to an axis (A, Fig. 4) which passes through a stand, and is caused to revolve very rapidly by pulling a string (S) wound around the axis, the colours will blend, so that the impression made upon the retina by one colour is not stronger than that made by any of the others. It was thought that white light was the result; but this may be proved to be an error by pasting a small strip of white paper across the indigo, blue, or any other dark-coloured segment, when it will be found that the colour caused by the revolution of the disc, contrasted with the white paper, is anything but white. Although somewhat out of place, we may remark, that if the electric light be employed to illuminate the disc during its rapid revolutions, the seven colours will be distinctly visible.

CHAPTER IV.

LIGHT AND ITS PROPERTIES.

COLOUR AND OTHER PECULIARITIES OF BODIES DUE TO LIGHT—DECOMPOSITION OF A SUNBEAM—FRAUNHOFER'S SPECTRAL LINES—ANTICIPATED RESULTS FROM EMPLOYING THE ELECTRIC LIGHT AS A PHOTOGRAPHIC AGENT—REFLECTION OF LIGHT FROM PLANE, CONVEX, AND CONCAVE SURFACES.

13. We have now to consider some of the properties of light, and therefore shall pass in review its leading characteristics.

14. Light is transmitted in all directions in straight lines (as in Fig. 5), and traverses about 192,500 miles in a second of time.

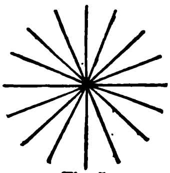
Fig. 5.

15. When a beam of white light (§ 8, 9) falls upon the surface of any body, effects are produced varying with the body upon which it falls. Thus it may be absorbed, and disappear entirely; or be nearly all reflected or thrown back; or it may pass through the body, and it is then said to be transmitted; and,

lastly, it may be partially absorbed, partially reflected, and partially transmitted.

16. The colour of bodies is due to the absorption of light. A body that absorbs all the rays will appear black, while one that reflects them, will seem white; but some substances absorb some of the rays and reflect the others. A yellow surface reflects the yellow rays, and absorbs the others; a blue surface reflects the blue; a scarlet surface absorbs all the rays except the red. Light is the cause of colour in animals, plants, and minerals; but what becomes of light that is absorbed by bodies is unknown: it may possibly be latent or hidden, the same as caloric or heat, and enter into combination with them, for it is evident that light may be extricated from some bodies without any change being produced, as in pyrophori or substances which absorb light, and emit it again when carried back into a dark place. The taste, odour, and combustibility of plants is due to the absorption of light; for a plant reared in the dark is nearly colourless, insipid, inodorous, and possesses very little combustible matter, because plants exhale the carbon in the form of carbonic acid when in the dark, while they absorb carbon when in the light, and exhale oxygen gas.

17. From what has been adduced before (§ 15), it is evident that *light is decomposed by absorption*, for when a beam of light falls upon a blue glass, the blue ray is separated from the rest of the rays of the spectrum and reflected, while the other rays are absorbed.

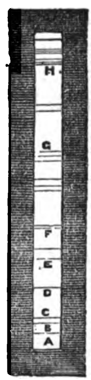

Fig. 6.

18. One of the most curious effects of the absorption of light is that which is discovered by examining the solar spectrum with a telescope. If this is done, numerous dark bands or lines (a representation of some of the larger of which is given in Fig. 6), are observed to be crossing the coloured rays. These bands, or lines, which are nearly 600 in number, are generally called Fraunhofer's dark lines, which have been demonstrated by Dr. Miller, the Professor of Chemistry in King's College, London, to vary continually with the alteration of the atmospheric conditions. This fact, which should be remembered, is of importance to the photographer, as will be explained hereafter. These lines are not found in the spectra of ordinary artificial lights, although they are discovered in those of the sun and the planets. In the electric spectrum,

the dark lines are replaced by brilliant ones, and the light is much clearer, so that we anticipate the day when the electric light will be used instead of the sun's light, with greater certainty, and perhaps more power.

19. If the same sunbeam that we admitted into the room a short time before, and allowed to fall upon the prism (§ 8) had been permitted to fall upon a polished metallic surface, the rays would have been *reflected* or turned into another direction, so that the angle of incidence would have been exactly equal to the angle of reflection. The angle of incidence means the angle formed by the line in which the light moves in a straight line perpendicular to the plane. For example, if the direction of the incident beam (*n i* in Fig. 7) be oblique to the plane (*m i m*), or surface of the reflecting body, then the beam will be reflected in such a direction (*i d*) that supposing a perpendicular imaginary line (*p i*) to be drawn between the incident beam and its reflection, the angle of reflection (*d i p*) is equal to the angle of incidence (*n i p*); consequently it follows, that the beam makes the same angle with the perpendicular, both before and after its reflection.

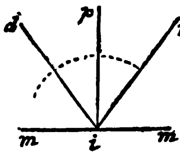

Fig. 7.

20. If we employ a convex surface to reflect from, instead of a plain one, the image will be reduced in size, and the outline be defective, because the imaginary, or virtual focus of reflection, varies for different parts of the same figure, while the central portion alone is correct.

21. If a concave reflecting surface is employed, the image becomes inverted, or turned upside down.

CHAPTER V.

LIGHT AND ITS PROPERTIES.

REFRACTION OF LIGHT—EXPERIMENTS TO PROVE THAT LIGHT IS REFRACTED—ANGLES OF REFRACTION—EFFECTS OF REFRACTION BY PRISMS—HOW TO CONSTRUCT A SIMPLE AND ECONOMICAL PRISM—EXPERIMENTS WITH PRISMS TO DEMONSTRATE THE REFRACTION OF LIGHT—CONSTRUCTION OF A PRISM EXPLAINED.

22. When a ray of light passes from one medium into another of a different density, it is turned out of its original course, and is then said to be *refracted*, the amount of refraction being proportional to the

density of the medium.* In passing from a rarer into a denser medium, it is refracted or bent *towards the perpendicular ;* but when it passes from a denser into a rarer medium it is refracted *from the perpendicular.*

23. We will try some simple experiments to prove the refraction of light) [Experiment 3.] Here is an empty jar (A B C D in Fig. 8). We will now place a shilling at the bottom of the jar, and you must direct your eye (E) in such a manner as just to see the edge of the shilling, while the rest of it is hidden by the rim of the jar (as at O G E). If water be now poured into the jar so gently as not to disturb the shilling, you will observe the money will appear to rise gradually until the water is level with the edge of the jar.

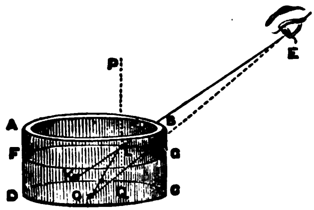

Fig. 8.

[The water is poured upon the money, which then appears to lie at K in the line E L K.]

The phenomenon you have just witnessed is thus explained:—When the water was poured into the jar (to the height F G), refraction took place (at L), from the perpendicular (P Q), and therefore the ray of light thus diverted from its original course (O G E), took another direction (O L E), and entering the eye (at E), the money appeared to be in another place (at K, in the line E L K).

[Experiment 4.] Here is a tumbler of water (*a*, Fig. 9), and you will see that when this paper-knife (*b d*) is placed in it that it will immediately appear to be bent from *e*, (as seen in Fig. 9, *b e c*).

[The experiment being performed, the refraction of the light takes place as it emerges from the water, so that the paper-knife appears as if it were broken at *e*.]

Fig. 9.

24. The angles of refraction are the angle of incidence, and the angle of refraction.

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* A *medium* is any transparent space through which light passes, such as water, air, glass, or even empty space. *Density* signifies the quantity of matter which a body contains, and is associated with weight; for example, a cubic inch of lead is more dense than the same quantity of wood. A *rarer* medium naturally explains itself, signifying a thinner or not so dense a medium.

25. *The angle of incidence*, in refraction as in reflection, is the angle which the incident ray (Fig. 10, *a i*) makes with the perpendicular (*p e*), which cuts the point of incidence (*i*).

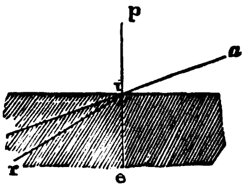

Fig. 10.

26. *The angle of refraction* is the angle made by the refracted ray (*i r*) with the remaining portion of the perpendicular (*i e*) at the point of incidence (*i*).

27. *The plane of refraction* is that which passes through the refracted ray (*i r*), and above the perpendicular (*p e*).

28. *The plane of incidence* is that which passes through the incident ray (*a i*), and the perpendicular (*p e*) at the point of incidence.

29. Some important optical effects may be demonstrated by refracting light with a prism,* as we have already seen (§ 8). In order to prosecute these experiments with advantage, we have the prism fastened to a brass stand (*b* Fig. 12, and *s* Fig. 13) fitted with a ball and socket-joint (*c* Figs. 12 and 13), so that it can be turned in any direction. By pushing the rod (*a*, Fig. 13) up or down the tubular stand (*s*, Fig. 13) into which it is inserted it may be raised to any height, and retained in the required position by means of a screw (*b*, Fig. 13), and, at the same time, the ball and socket-joint (*c*, Figs. 12 and 13) will allow it to be inclined to any degree.

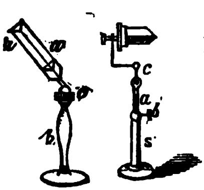

Fig. 12. Fig. 13.

30. If the prism is placed in such a manner that the refracting edge is directed upwards, on looking through it you will observe two remarkable phenomena—all objects appearing to be raised from their proper position. But let us examine for ourselves. [Experiment 5]. Here is the prism

* A simple kind of prism may be constructed by providing two slips of common window glass (*a a* Fig. 11), and affixing them to a lump of soft bees-wax (*c*), so that the necessary angle is formed, and the ends of the strips are held together by a similar piece of wax at either end; after which some pure water (*b*) is poured into the trough thus formed. By this means, some of the most beautiful experiments in connexion with light may be illustrated and tested by the most juvenile of our readers.

Fig. 11.

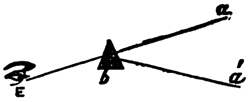

Fig. 14.

(*b*, Fig. 14), and on bringing the eye (E) into the proper position, and looking at the silver spoon placed below (*á*), it will appear to be raised considerably above (*a*). You also observe that it has coloured edges, so have all objects seen in this manner (§ 8, 9, and 10). Now, if the refracting edge had been directed downwards, the spoon would have appeared to be removed still further downwards; and had the prism been placed vertically, the spoon would have been displaced to the left or right, just as we directed the refracting edge * towards the object observed.

31. From what we have seen (§ 30) it appears that all objects observed through a prism appear to be removed towards the direction of the refracting edge.

32. If a prism is made of a strongly refracting substance, it will cause the rays of light to deviate much more than if the same shaped prism was constructed of a substance possessing less refractive power.

33. The rays of light will be refracted more or less according to the difference of the refracting angle of the prism. For example, if its angle be 60°, the deviation of the rays of light will be greater than if the angle were only 30°, and so on.

CHAPTER VI.

THE ACTION OF LENSES.

THE REFRACTION OF LIGHT BY LENSES IMPORTANT TO PHOTOGRAPHERS —DIFFERENT FORMS OF LENSES—PARTS OF A LENS—THE GENERAL ACTION OF LENSES AND THEORY OF ACTION—PROPERTIES OF LENSES —THE FORMATION OF IMAGES BY LENSES.

34. EVERY young photographer should understand the principle upon which the necessary apparatus is constructed, and therefore we have considered it requisite to explain the various phenomena as simply as possible.

* The different parts of a prism may be thus explained. The *base* is any one of its surfaces opposite to one of its refracting edges, whether real or imaginary; it *refracting angle* is the angle made by any two surfaces of its body; its *edge* is the line in which its surfaces intersect, or would intersect each other, if their boundary lines were prolonged.

35. We have already become acquainted with the eading points of the phenomena of refraction, and shall now have to consider the refraction of light by lenses.

36. A lens is a transparent body, possessing the property of increasing or diminishing the natural convergence of the rays of light which pass through it. All transparent media having polished spherical surfaces, are generally called lenses, the term lens being originally applied from their resembling a lentil seed.

37. There are seven different forms of lenses (Fig. 15), resulting from the combination of plane and spherical surfaces, either separately or connectedly. 1. The sphere or globe. 2. The double convex, bounded by two externally convex spherical surfaces, the radii* of which may be equal or unequal. 3. The plano-convex, in which one surface is plane and the other convex. 4. The double concave, in which both surfaces are concave, and their radii equal or unequal. 5. The plano-concave, in which one surface is plane and the other concave. 6. The concavo-convex, or *meniscus*,† bounded on one side by a convex, nd on the other by a concave surface. 7. The

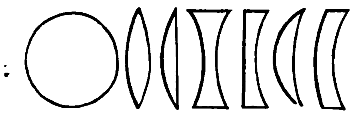

Fig. 15.

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* *The radius* of a lens (*d e* Fig. 16), is an imaginary line drawn from its centre towards its circumference; therefore it is the radius of the sphere of which its surfaces form a part. But if these surfaces differ, or do not have the same curvature, then the radius of each will also be different. *The axis* of a lens is the straight line (*f e*) uniting the centre of both the spherical surfaces by which the lens is formed. In plano-concave, and plano-convex lenses, the axis is the perpendicular line passing from the centre of curvature to the plane. *The aperture* of a lens (*a b*) is the surface within its circumference. *The optical centre* (*d*) is the point where the opposite surfaces are parallel; and the *geometrical centre* (*c*) is a point situated on its axial line, in the centre of the curvatures of both its surfaces. A lens is said to be *exactly* or *truly centred*, when its optical centre is situated at a point on its axis equally distant from similar parts of its surface in every direction; if the lens is not truly centred, objects will appear altered in their position when the lens is turned round perpendicularly to its axis.

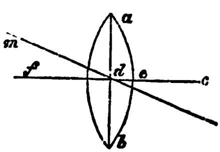


Fig. 16.

† So called because it resembles a little moon.

convexo-concave lens, bounded by a convex surface on one side, and by a concave one on the other; but these surfaces do not meet when produced.

38. The general action of lenses of all kinds may be understood by remembering the effects produced by prisms (§ 30, 31, 32, 33). A ray of light when it is refracted is bent towards the back of the prism; and if we take two prisms and place their bases together (as in Fig. 17, *a c e*, *b c e*), and then allow two parallel rays of light (*m* and *n*) to fall upon them, these rays, after refraction, being being bent towards the back of the prism, will intersect each other (at the point *f*). Therefore if we imagine a double convex lens to be formed of two prisms (such as are seen in Fig. 17), we shall be better able to understand how parallel rays converge to a focal point when they fall upon the surface of the lens.

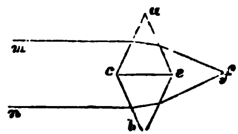


Fig. 17.

39. Let the same two prisms be placed with their edges touching each other (as in Fig. 18), and then let two parallel rays (*m n*) fall upon them. It will be found that the rays diverge instead of converging, as they emerge from the back of the prisms (as seen at *f*, as it passes through *a b c*, and *g* as it passes through *a d e*). This experiment enables us to understand how parallel rays are made to diverge by means of concave lenses and how divergent rays are rendered still more divergent by the same means.

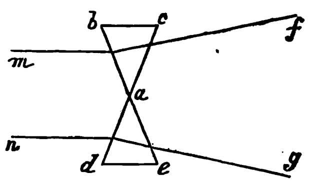


Fig. 18.

40. *Convex lenses* possess the following properties, which are demonstrated by the aid of the law of refraction:—1. Every principal ray which falls upon a convex lens of limited thickness, passes through without altering its course. 2. Rays parallel to the axis of a double convex lens, whose surfaces have both an equal radius, are (see footnote to § 37) brought to a focus at a distance from the optical centre equal to the radius of curvature of the lens. In a plano-convex lens, the focal point is twice the radius of the curved surface of the lens. The focus for parallel rays is called the *principal focal point* (F, Fig. 19). 3. Rays diverging from the principal focus of a convex lens after refraction, become

Fig. 19.

parallel (as in Fig. 19). 4. If rays diverge from a point in the axis more distant than the principal focus they converge after refraction, and it will then be found that their point of convergence is nearer the lens in proportion as the point from which they radiated was more distant. 5. Rays which proceed from a point in the axis nearer than the principal focus diverge after refraction (as in Fig. 20), so that the lens is no longer able to make the rays converge, or even merge parallel.

Fig. 20.

41. *Concave lenses* possess the following properties:—1. Every principal ray is transmitted without changing its course. 2. Rays parallel to the axis diverge in such a manner that they appear to issue from the focal point of divergence (F, Fig. 21). If, however, the point of origin is nearer, and the incident rays consequently more divergent, it follows that the divergence of the rays after their transmission through the lens is greater than the divergence of the parallel incident rays (Fig. 21). 3. If the incident rays converge towards the focus (F, Fig. 21) on the other side of the lens, the refracted rays emerging from the glass are occasionally parallel to each other. 4. If the incident rays converge more strongly they will still converge after being refracted; but if they converge towards a point (*a*, Fig. 22), lying at a greater distance from the glass than the principal focal point (*f*), they will still diverge as if they came from a point (*b*) before the lens. 5. A meniscus, or concavo-convex lens, produces the same effect on rays of light as a convex lens, and corresponds with it in focal distance. 6. A convexo-concave lens produces the same effect as concave lenses, agreeing with them in focal distance.

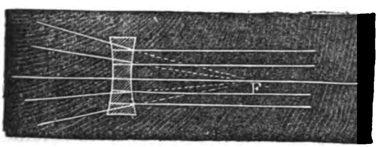


Fig. 21.

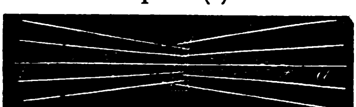


Fig. 22.

42. The manner in which images are formed by means of lenses

will be readily understood by reference to the accompanying diagrams.

In Fig. 23, you observe that L L′ represent a double convex lens, which is supposed to be placed in front of a screen. If an object, such as an arrow, M N, be placed before it, the image will be seen on the screen in an inverted position, as *m n*. The

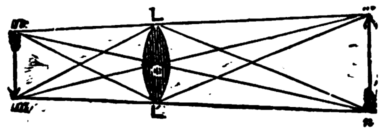


Fig. 23

reason is this: from the point N, all the rays, N L, N C, N L′, after refraction converge to a focus at *n*, and all the rays, M L, M C, M L′, proceeding from the point M, converge to a focus at *m*; and from every intermediate point between M and N, intermediate foci will form between *m* and *n* to produce the inverted image. The size of the image depends upon the distance of the object from the lens. For example, the nearer the object is to the lens the larger will be the image, and the more distant the object, the smaller will be the image. As an object is advanced towards the lens the image recedes and becomes larger in proportion. When an object is at a distance equal to twice the focal distance, the image is equidistant from the lens or the opposite side, and is of the same size as the object.

43. Lenses give images small in proportion to the shortness of the focal distance, and enlarged images of small objects placed near to their focal point. At an equal distance from the lens, the images will be larger in such lenses as have a small focal distance, because the object is nearer the lens.

44. If the object be within the focal distance of the lens, no convergent image of it can be formed, because the rays proceeding from a point which lies nearer to the glass than does the focus, still diverge after their passage through it. Let us suppose that the arrow, A B, (Fig. 24) represents an object lying within the focal distance; then the rays passing from A will diverge after they pass through the lens L L as if they proceeded from *a*; and the rays from B, as if they proceeded from *b*. If the eye be placed on the other side of the lens at *c*, which is just at the focal point, it

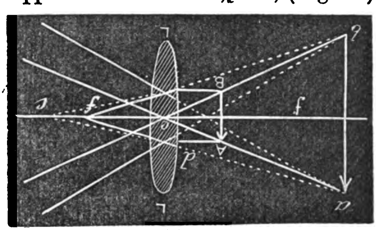


Fig. 24.

will receive the rays of light issuing from the object, A B, in the same manner as if they had proceeded from *a b;* and therefore *a b* is the image of A B. The object and image both lie within the angle *a b c;* but the object being nearer the lens, we see the image larger than the object.

45. Concave lenses do not produce convergent images, but only such as arise from convex lenses when the object lies within the focal distance. As a concave lens causes the rays proceeding from a point to diverge as if they came from a point lying nearer to the glass, it is evident that the concave glasses yield diminished images of objects, as may be seen in Fig. 25, where A B represents the object, L L the lens, and *a b* the image, the direction of the rays being shown in the figure.

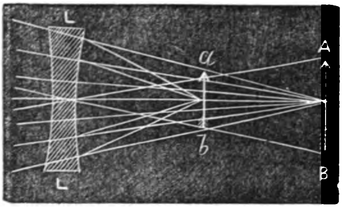


Fig. 25.

We here take leave of the science of Photography, practical and interesting illustrations of which our boys will find amongst the Scientific Recreations of our "Indoor Sports and Pastimes."

THE STEREOSCOPE.

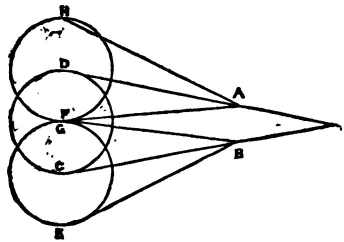
The name *Stereoscope*, from the Greek words *stereos*, solid, and *skopein*, to see, has been given to an instrument of recent invention, for exhibiting in true relief and apparent solidity all objects, or groups of objects, by combining into one picture *two* representations of these objects on a plane, as seen separately by each eye.

If we hold up a thin book between our two eyes, with its back towards us, and at the distance of about a foot, we shall see the back and the two sides of the book when both eyes are open; but if we shut the *right* eye, we shall see with the *left* eye only the back and *left* side of the book; and if we shut the *left* eye, we shall see only the back and the *right* side of it. Or, to use a more homely illustration, when we shut the *left* eye, we see only the *right* side of our nose with the *right* eye; and when we shut the *right* eye, we see only the *left* side of our nose with the *left* eye. And in general, when we look at any solid object whatever, the right eye sees parts of it towards the right hand not seen by the left eye, and the left eye sees part of it towards the left hand not seen by the right eye. Hence we arrive at the first and fundamental truth on which the theory and construction of the Stereoscope depend, viz.: 1, When we look with two eyes upon any solid body or object whose parts are at different distances from us, the picture of it which we see with the right eye, or the image of it which is formed on the retina of the right eye, is different from the picture of it which we see with the left eye, or from the image of it which is formed on the retina of the left eye.

The second fundamental truth on which the theory and construction of the Stereoscope depend is: 2, When the two dissimilar pictures of any solid body, as seen by each eye separately, are superimposed, or laid the one above the other by the convergency of the axes of the two eyes, the object which these pictures represent is seen in relief, or as a solid body, with its different parts at different distances from the observer.

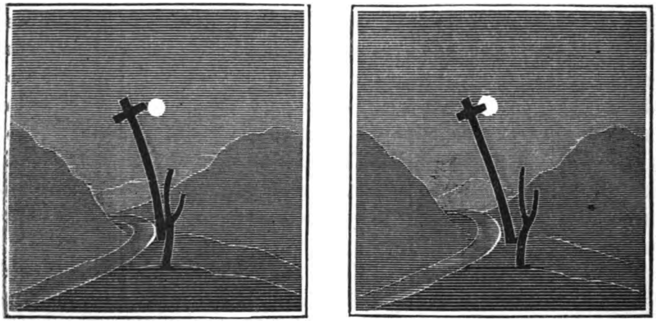
Although this truth is not distinctly stated either by Euclid or Galen, we can hardly suppose that they were ignorant of it, as it is a necessary result of their observations. Since we do see an object in true relief by both eyes, and since the picture of the object which we see is formed by the superposition of the one dissimilar picture above the other, the vision in relief is the necessary result of the combination of the pictures. They must have known it simply as a fact, though they did not know its cause.

Baptista Porta and Aguilonius, however, were well acquainted with this second truth. In explaining the experiments of Galen on the dissimilarity of the pictures of an object as seen by each eye and both, Porta employs the annexed diagram, which is much more distinct than that which is given by the Greek physician. "Let A," he says, "be the pupil of the right eye, B that of the left, and D C, the body to be seen. When we look at the body with both eyes, we see D C, while with the left eye we see E F, and with the right eye G H. But if it is seen with one eye, it will be seen otherwise; for when the left eye B is shut, the body C D, on the left side, will be seen in H G; but when



the right eye A is shut, the body C D will be seen in F E; whereas when both eyes are opened at the same time it will be seen in C D." Porta then proceeds to explain these results by quoting the passage from Galen in which he supposes the observer to repeat these experiments when he is looking at a solid column. In the preceding diagram we see not only the principle but the construction of the Ocular Stereoscope, or the method by which we combine the two pictures by looking at a point between them and the observer, or beyond the pictures. The two dissimilar pictures are represented by H E; the picture as seen by one eye by H G; the picture as seen by the other by E F; and the picture of the solid column in full relief by D C, as produced midway between the two dissimilar pictures H G and F E by their union, precisely as in the Stereoscope.

The important subject of which we are treating has been discussed by Aguilonius with singular ingenuity; and his observations are so interesting, that we shall give them in his own words. "When one object," he says, "is seen with two eyes, the angles at the vertices of the optical pyramids (viz. H A F, G B E) are not always equal; (they are equal in the vision of a sphere and a cylinder;) for beside the direct view, in which the pyramids ought to be equal, into whatever directions both eyes are turned they receive pictures of the objects under unequal angles, the greater of which is that which is terminated at the nearer eye, and the lesser that which regards the remoter eye. This, I think, is perfectly evident; but I consider it as worthy of admiration, *how it happens that bodies seen by both eyes are not all confused and shapeless,* though we view them by the optical axes fixed on the bodies themselves. For greater bodies seen under greater angles appear lesser bodies under lesser angles. If, therefore, one and the same body which is in reality greater with one eye, is seen less on account of the inequality of the angles in which the pyramids are terminated, the body itself must assuredly be seen greater or least at the same time, and to the same person that views it; and therefore, since the images in each eye are dissimilar, the representation of the object must appear confused and disturbed to the primary sense." In order to understand this passage, we must state, as a well-known fact, that in binocular portraits the distance between the tip of the nose and the tip of the ear is greater in the one picture than in the other, and consequently the line joining these points subtends a greater angle in the one than in the other. When these two lines, therefore, are combined, Aguilonius concludes that the vision of the tip of the nose and the tip of the ear must be confused, as the ends of the lines cannot be united.



"This view of the subject," he continues, "is certainly consistent with reason; but what is truly wonderful is, that it is not correct, for bodies are seen clearly and distinctly with both eyes when the optic axes are converged upon them. The reason of this, I think, is, that the bodies do not appear to be single, because the apparent images which are formed from each of them in separate eyes exactly coalesce (*sibi mutuo exacte congruunt*), but because the common sense imparts its aid equally to each eye, exerting its own power equally in the same manner as the eyes are converged by means of their optical axes. Whatever body, therefore, each eye sees with the eyes conjoined, the common sense makes a single notion, not composed of the two which belong to each eye, but belonging and accommodated to the imaginative faculty to which it (the common sense) assigns it."

Now though the explanation here given of the distinct appearance of the solid composed of two dissimilar pictures is not correct, yet Aguilonius clearly asserts the second truth, that though the unequal lines and angles do not coalesce, yet the body is seen distinctly and in its true solidity, in consequence of the combination of the two pictures of it as seen by each eye.

From these details it is manifest that the *two* fundamental truths on which the Stereoscope depends were well known to Aguilonius and others; and that nothing more was wanted than a method of forming two dissimilar pictures of objects, and a method of uniting them when formed.

Upwards of thirty years ago, Mr. Elliott, now a teacher of mathematics in Edinburgh, was led to study the subject of binocular vision, in consequence of having written an essay in 1823, for the Logic Class: "On the means by which we obtain our knowledge of distances by the eye." From that time he was familiar with the idea that the relief of solid bodies when seen with both eyes was produced by the union of the two dissimilar pictures of them as seen by each eye, which he believed was known to every student of vision.

In order, however, to show the effect of the instrument to his friends, he constructed a rude picture of a landscape, as seen by each eye separately; and when these two pictures were placed in his instrument, the parts of the landscape appeared at different distances from the eye, or in their true relief. As this was undoubtedly the first landscape constructed for, and seen in relief through the Stereoscope, it possesses much interest; and we have given an accurate copy of the dissimilar pictures in the annexed diagram, as they were placed by Mr. Elliott, at the farther end of a box 18 inches long, 7 broad, and 4½ deep. In their present position they will appear in relief when united by the Stereoscope, or by converging the optic axes to a point at a proper distance beyond them. Had photography been in existence, to enable Mr. Elliott to obtain binocular pictures of landscapes and other objects, the application of the Sterescope to natural scenery and to portraiture would not have been so long delayed.

In the month of August, 1838, Mr. Wheatstone exhibited an instrument, under the name of the Reflecting Sterescope, to the British Association which met at Newcastle.

"The Reflecting Stereoscope of Mr. Wheatstone was at this time," as the Abbé Moigno remarks, "almost completely forgotten." Its merits had never been sufficiently understood; and even the Lenticular Stereoscope, after photography had supplied it with binocular portraits, excited a very limited interest. I offered it gratuitously to opticians in London and Birmingham; but it was not till the year 1850, when I took one to Paris, and showed it to the Abbé Moigno and M. Duboscq, that it was appreciated and brought into notice. Having executed a number of binocular pictures of statues and bas-reliefs, and portraits of celebrated individuals, M. Duboscq, to use the words of Abbé Moigno, 'showed the wonderful effects of the instrument to natural philosophers and amateurs, who flocked to him in crowds, and from whom they elicited a spontaneous and unanimous cry of admiration.'"

Such is the brief history of the Lenticular Stereoscope, and of its introduction into Paris and London. It is now in general use over the whole world, and it has been estimated that more than half a million of the Lenticular Stereoscopes have been sold. Photographers are employed in every part of the globe in taking binocular pictures for the instrument,—among the ruins of Pompeii and Herculaneum,—on the glaciers and in the valleys of Switzerland—among the public monuments in the Old and New World—in the museums of ancient and modern life—and in the sacred precincts of the domestic circle.

OUTLINES OF GENERAL SCIENCE.

COAL.

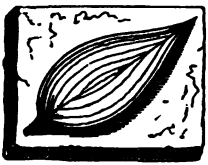
We shall now treat of General Science, and if our dear boys will give us their attention, we promise to interest and instruct them. We shall first show them the wonders and marvels springing from Coal:—

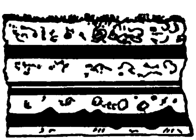
If you could go down into a coal-pit, you would be surprised to find that the roof was covered with vegetable remains partially converted into coal: leaves, branches, and stems of the most elegant forms are embedded in the dark shining surface, hundreds of feet below the top of the ground. In these large slabs of slaty coal above your head, you find that layer after layer of leaves, blackened and half-petrified, could be flaked off, the whole mass being formed of leaves and stems closely pressed together in clay. A gentleman who visited the coal mines in Bohemia said, that the most elaborate imitations of living foliage on the painted ceilings of Italian palaces bore no comparison with the beauteous profusion of vegetable forms with which those instructive coal mines were overhung. The roof was covered as with a canopy of gorgeous tapestry, enriched with festoons of most graceful foliage, flung in wild irregular profusion over every portion of its surface.

COAL SHAFT.

Not only the roof bears evidence of vegetable growths, but the floor, the sides, and the coal which has been dug out and carried away. The black mineral burning in the grate, upon examination by the microscope, and by chemistry, turns out to be vegetable matter and nothing else, changed in a slight degree, but only just so much as to give a clue to the nature of the means which produced the alteration.

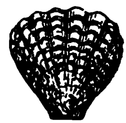
If you can procure a little clay, make it into two pads of equal size, say two inches square. Let the clay be very moist when it is worked into these two pair of little tiles. Between each pair of clay-pads lay a leaf or a piece of fresh moss, and having wetted the surface of each pair, press them closely together, so that all air may be excluded from the leaves, and the clay may be incorporated at the edges. You will then have two flat bricks of clay, each inclosing a portion of vegetable tissue. These bricks you must allow to dry slowly, to prevent them cracking; and, for this purpose, they should bo laid where the sun can shine upon them for five or seven days. At the end of that time, one of them may be laid in a wet ditch bottom, where it can be found when wanted, or deposited in a flower-pot in a similarly wet situation for two or three months; the other may be used for an experiment, which will give a more immediate result. Having placed it between two pieces of tin, or any other material which will prevent the little brick being broken, thrust it into the fire, and allow it to remain there till it has become thoroughly burned. Having removed it and allowed it to get cool, split the pads from each other, and you will find a black impression of the leaf, which has been converted into a species of coal, The leaf in the other piece of clay will have been similarly blackened, and another species of coal produced. If you could examine the layers





or strata of coal as they are found in the earth, you would find that they are usually composed of vegetable matter of this character, lying between plates or layers of limestone, which bears upon its corresponding surfaces all the impressions of the surface of coal with which it comes in contact. In this limestone you would be surprised to find shells which are of sea origin.

How could these things come into such a situation hundreds of feet below the surface of the ground, and scores of miles from the sea? How came these gigantic fern-leaves, and other cellular plants, which now grow only in a tropical temperature, to be thus buried in a northern climate? One thing is evident, that it would be as impossible for the foundation of a house to be built last, as for the coal to have been put where it is now found, *after* the formation or deposit of the rocks which, in vast beds, lie upon and above it, The shells of the marine animals prove that the sea had something to do with the formation, and the leaves prove that the dry land had appeared. From the nature of the shells we learn that the animals which had inhabited them were such as are found in shallows near the mouths of rivers or estuaries. From the nature of the plants we learn that the land was boggy, that the atmosphere was moist, and the temperature very high. From both we learn that there were rivers which flowed into the sea, and carried down in flushes large quantities of vegetable matter, which they deposited in the sea. Upon the vegetable matter settled down, in turn (as is now the case in the mouths of our rivers) layers of sand, which entombed the shells. Immense epochs elapsed while this process was going on, during which the superincumbent pressure, and the internal heat of the earth, changed the vegetable matter into *coal.*



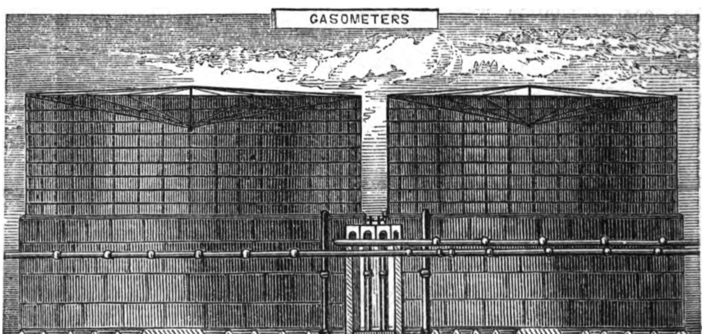
Of the volcanic disturbances which took place about the time when the coal formation was in process of deposition, there is sublime evidence to be derived from the manner in which some of the strata or layers have been broken and tilted up, as in the diagram. At Newcastle, coal is found beneath the sea many hundreds of feet; while at Huanoco, in Peru, it is discovered at an elevation of 12,800 feet above the sea level, and covered with eternal snow. There, raised about two miles and a half above the present ocean, and where the roar of its waves never reaches, are the skeletons and shells of animals who lived and sported in the primæval seas.

Upon the possession of the valuable coal strata has depended, in a principal degree, the power and greatness of England. The product of the British coal-fields is more than double that of the whole of the rest of Europe, and the annual value of the collieries cannot be estimated at less than ten millions of pounds sterling.

Nor is this all. Side by side with the coal which is used for smelting, lies the iron ore, or clay iron-stone, to be smelted. Without the coal, the iron would have been of comparatively little use; and without the iron the coal would have been limited in the extent to which it could have been used. From iron springs machinery, steam-engines, steam-boats, and railways. But coal was necessary to them all.

Still there is more to be said. From the layers of limestone of which I spoke, we derive three other important things. Materials for building of various qualities, lie here among the other rich treasures; to the beauty of the stone the city of Glasgow bears witness. Lead also is found here; and the substance from which it is obtained affords *lime*, without which we could not use the stone.

GAS.



AGAIN at the fireside, let us look round and see if we cannot find something further to interest and amuse us. We have talked about the coal—its wonderful history, and useful companions; among which were enumerated the iron, which forms the grate, the fender, poker, and shovel; and the limestone which supplies materials to build our houses. This will have thrown some light upon the history of the marble mantel-piece, which tells a similar romantic history to that which we learned from coal. But the mantel-piece is cut from strata, or layers of stone, in the earth, which consist of animal, not vegetable, remains. Indeed, many pieces of marble may be said to be formed of nothing else but the ruined houses of millions of generations of little insects, heaped together and united into one solid mass by water, heat, and the influences of time.

There is yet the *smoke;* of that we have not hitherto spoken. See how stealthily it rushes out between the lumps of coal, and flies away up the chimney—now white, now blue, now all on fire! A perpetual stream of little clouds seem to hurry off, each wreath of vapour apparently struggling with its fellow which shall reach the top of the chimney first. Whence comes these fumes? and what power has set them free from the prison-house in which they have been shut up till now?

First, however, let us inquire *what* this smoke is? We have previously explained to you some of the effects of heat. You remember that it had the power of expanding air, so that a certain space contains fewer particles of warm than of cold air; that bars of iron, or other substances, increase in length and size when heated; and that, as a general rule, the particles of all bodies are forced farther asunder by this power. By its influence solids become fluids, and fluids become vapours. Try the following experiments:—Having procured an iron spoon, place upon it a small piece of ice, and hold the spoon over the flame of the candle; the solid ice will melt, and form the fluid called *water;* the water will presently boil, and form the vapour named *steam.* Here you have the three conditions of matter—solid, fluid, and gaseous. All these conditions depend upon the possession of certain proportions of latent heat, or caloric, combined with them. Solids contain *least,* and gases *most* of this latent heat. If you cannot procure ice, you may perform the experiment with a small lump of common bees-wax, the size of a pea. This, perhaps, is the more instructive experiment of the two, since the vapour which rises from the wax can be set on fire. In this experiment you see a solid converted into a *smoke,* which is inflammable, or capable of burning; and this is precisely what happens to the coal, which being heated, has its particles forced asunder, till the solid mineral becomes a light smoke or gas. It is called *carburetted hydrogen*, because it is composed of carbon, and an inflammable gas called *hydrogen*. This carburetted hydrogen is the gas which is used to light the streets and shops of large towns.

Though coal gas is now so generally used for illumination, it was not known to the public of London till 1803. Till then, dim and dirty oil-lamps were hung in the London streets and alleys.

The discovery of gas was made in a simple manner by the Rev. Dr. Clayton, who endeavoured to obtain a *spirit* from coal by a similar process to that now prevailing, and called distillation. He found that when coal is heated red hot, in closed vessels, it yielded a vapour which took fire at the end of the tube along which it escaped. In manufacturing the gas usually burnt, the coal is placed in large cast-iron cylinders, called *retorts*, to which pipes are fixed to carry off the gas, but which are otherwise completely closed. The retorts being heated, the coal begins to give off a large quantity of smoke. This, however, contains steam, vapour of tar, and other impurities, which are removed by passing it through cold water, lime, &c.

These various processes having separated the impurities which would have destroyed the brilliancy, or illuminating power of the gas, the remainder, which is carburetted hydrogen, is collected in a large receiver—improperly called a *gasometer*. From this receiver it is forced through pipes to the lamps for which it is intended.

We will now give directions how to manufacture an impure carburetted hydrogen, or coal gas, on a small scale. We hold here in our hand part of a common tobacco-pipe; we have selected, moreover, a little nub of coal, which easily goes into the bowl of the pipe without fitting very close at the sides, and having put it into its place, we fill in with small grains of coal lightly. We shall now proceed to cover the whole of the top of the bowl with a cap of wet clay, so as to make it quite air-tight, and then lay it by for a while to allow it to dry. The coal is arranged in the manner described, to prevent the clogging up of the outlet of the pipe. As soon as the clay is dried, the bowl of the pipe may be thrust carefully (so as not to break or crack the cap) into a red part of the fire, leaving the stem to stick out an inch or two, according to its length. At first steam—the vapour of the water contained in the clay and the coal—will be distilled, or driven out by the heat; but presently

a stream of gas will follow, which may be lighted, and which will burn for a minute or two, more or less brilliantly, according to the nature of the coal. The pipe being removed from the fire with the tongs, and placed in a cool place, will soon be ready for examination. The nature of the coal which was placed in it has undergone a change, and will not now blaze if put into the fire. It has been transformed into *coke*, which, on account of its burning without flame, is used for drying various articles of commerce. It is almost pure carbon, and has been shown to consist of exceedingly minute crystals of diamond!

MECHANICAL PRINCIPLES.

THERE are many things about the fireside which *yet* remain to be examined by the eye of philosophy; and since, to accustom yourselves to dispose of one subject before passing to another, is a good habit of the mind, and should be encouraged, we shall proceed to explain the prominent objects which we find close to our hands in this our magic circle.

Here you see are the poker, tongs, and shovel; simple common things enough, you will say, but upon the principles of their action depend nearly all the mechanical contrivances which excite so much wonder: on the top of the fire sings the tea-kettle, whose breath is that powerful agency which whirls the traveller along the railroad, or turns the ten thousand spindles in our cotton factories—and rushing fast up the chimney is heated air, which inflated the first balloon, and taught man how to rise from earth and sail about in air. Each of these subjects, in turn, we propose to explain; and, to begin, we will take the "fire-irons," as they are called. Of these the most useful is the poker. It is a model of an instrument called a *lever*. When we poke the fire we push the point of the poker underneath a mass of coal, and then using the bar of the grate as a prop, we lower our hand, and in so doing, raise the burning embers. In the diagram, A, the poker, is the *lever;* B is the bar of the fire-grate, which is the prop, or, as it is called in mechanics, the *fulcrum;* C is the coal, or *weight*, which is raised; and D is the point at which the downward pressure or *power* is applied. To enable you to have clearer ideas of this important

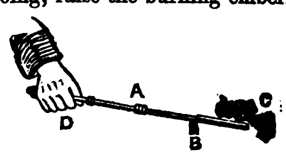
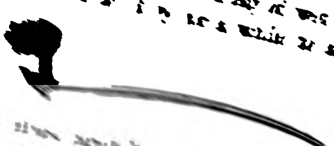


Fig. 1.

... carburetted hydrogen, because it is composed of carbon, ... gas called hydrogen. This carburetted hydrogen ... the streets and shops of large towns. ... so generally used for illumination, it was ... of London till 1813. Till then, dim and ... the London streets and alleys.

... gas was made in a simple manner by the Rev. ... to obtain a *spirit* from coal by a sim... and called distillation. He found ... in closed vessels, it yielded a va... of the tube along which it escaped. ... the coal is placed in larg... which pipes are fixed to carry ... completely closed. The retort... of a large quantity of smoke... of tar, and other impurities ... cold water, lime, &c. ... separated the impurities wh... illuminating power of the ... hydrogen, is collected ... *gasometer*. From this rec... for which it is intended.

... to manufacture an i... small scale. We hold h... we have selected, moreov... bowl of the pipe with ... its place, we ... proceed to cover ... so as to mak... allow it to dry.



... in the mann... vent the clog... of the pi... is dri... so as not to break or ... the steam to stick ... the vap... be distilled a stream of gas will follow, which may be ... for a minute or two, more or less brilliantly ... coal. The pipe being removed from the fire ... a cool place, will soon be ready for examination ... which was placed in it has undergone a ... if put into the fire. It has been ... count of its burning without flame ... commerce. It is almost pure carbon ... exceedingly minute crystals of diamond.

MECHANICS.

There are many things ... examined by the eye of ... dispose of one subject before ... mind, and should be ... nent objects which we ...

Here you see ... enough, you will ... nearly all the ... the top of the ... agency which ... thousand spindle ... ney is heated ... to rise from ... we propose ... they are ... an instrument ... the ...

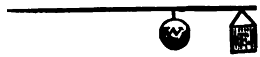


Fig. 4.

...ite sugar into small lumps ...ll boats upon the river. In

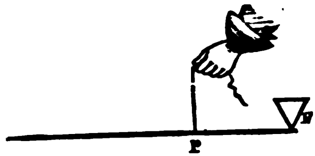


Fig. 6.

...rum is to the resistance or weight, ...tween the fulcrum and power, the ...ade to be used separately, each by ... rower to sit at the opposite side

...s second class joined together; the ...nce in the shell of the nut, and the ... are the ends of the levers. The ... a lever of the second class; the ...istance.

... *is between the fulcrum and the* ... you an idea of what we mean. ... is gained: thus for *one* inch ... would ascend nearly *three* ...

...ender are composed

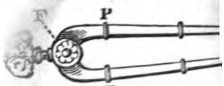


Fig. 7.

...n ...s ap- ...or resistance. The common we mechanical instrument, we have drawn another diagram, which it is important you should understand. A, B, C, is the lever or stiff rod; W is the weight, F the fulcrum or prop, and P the power. Now it is found, that if the length of this lever from A to B was four feet, and the length from B to C only one foot, one-pound weight hung from the end A would balance a four-pound weight attached to the end C. By the lever, you have thus gained a power equal to three pounds.

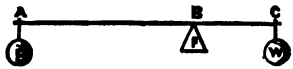


Fig. 2.

When you push a spade into the earth, you use a lever of the same kind as the poker, and raise a weight of earth which you could not move without some such mechanical power. A spade is usually about four feet long; the shaft, or handle, being rather more than three feet, and the blade, or iron part, rather less than one and a half, consequently a pressure downwards upon the handle, equal to *four* pounds, will raise more than *eight* pounds' weight (or resistance) of the soil. The power is applied at the handle, the earth at the back of the spade is the prop or fulcrum, and the earth in front is the weight to be raised.

The common crow-bar, by which one man may move stones or timber weighing many times his own weight, is an example of the same kind of lever. Sometimes, for convenience, these instruments are curved for particular uses, as in Fig. 3, where a nail fixed in a piece of wood is the weight to be raised, or resistance to be overcome. The power is applied at P, and the wood itself becomes the fulcrum, owing to the curved shape of the instrument. A lever of this form is made in the heads of common hammers. Sometimes two of such levers are combined, as in the common pincers, where the pivot forms the fulcrum, and the body nipped is the resistance or opposing weight.

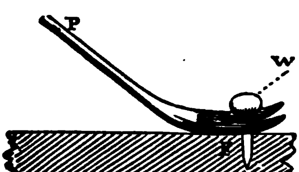


Fig. 3.

A pair of scissors affords us another example of a compound lever of the same kind. In all these instances, it should be observed that the fulcrum, or prop, is *between* the power and the resistance (or weight), and that when this is the case, the lever is said to be, for the sake of distinction, of the *first* kind. There are two other relative positions of the power, resistance, and fulcrum, which require to be distinguished. The diagram, Fig. 4, will explain the construction of a lever of the second class. There the weight to be raised, or the resistance to be overcome, is *between the fulcrum and the power*. A familiar example of this kind of lever reversed, is the old-fashioned nipper used in the grocers' shops to break the white sugar into small lumps (Fig. 5), or the oars used to propel the small boats upon the river. In all these instances, the nearer the fulcrum is to the resistance or weight, and the greater the length of lever between the fulcrum and power, the more power is gained; hence oars made to be used separately, each by one man, are so made as to require the rower to sit at the opposite side to that in which his oar works.

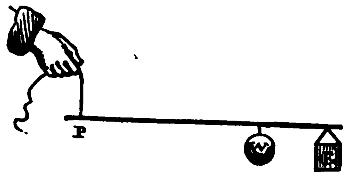


Fig. 4.

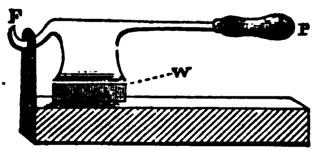


Fig. 5.

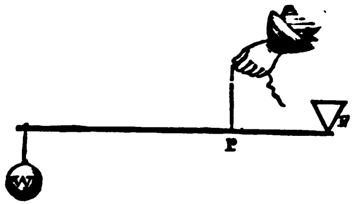


Fig. 6.

Nutcrackers are two levers of this second class joined together; the fulcrum is at the hinges, the resistance in the shell of the nut, and the power is applied at the handles, which are the ends of the levers. The common door is another illustration of a lever of the second class; the hinge is the fulcrum, and the air the resistance.

In the third class of lever, the *power is between the fulcrum and the weight*, or resistance. The Fig. 6 will give you an idea of what we mean. In this lever power is lost, but *velocity* is gained: thus for *one* inch movement upwards at P, the weight W would ascend nearly *three* inches. The tongs there lying on the fender are composed of two levers of this kind: F is the fulcrum; P indicates where the tongs should be grasped by the hand; or, in other words, where the power is applied; and W the cinder, or resistance. The common weighing-beam

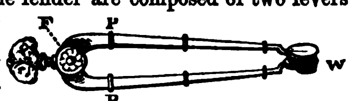


Fig. 7.

is a simple form of a lever of the third class. The most beautiful application of this lever occurs in living animals. In the movements of these the greatest rapidity is requisite, and by a wonderful provision, power of muscle increases as required. The velocity of the greyhound, the fleetness of the swallow, the marvellous glancing of the fish, the startling flutter of the bat, the spring of the ponderous tiger, the leap of the leaf-like grasshopper, the erratic whirling of the velvet butterfly, the giddy dance of the summer flies, and lastly, the inconceivable rapidity of the motion of the wings of bees, who on a warm day stand without the gates of their city, and, singing, fan the entrance to the hive, are instances of the application of this power.

A majority of the muscles connected with motion in the bodies of animals are attached to the bones as the power is applied in levers of the third class. Fig. 8 represents a diagram showing the attachment of the muscle by which we chew our food. A represents the *masseter* muscle, the contraction of which can be felt by the hand on the side of the cheek when the teeth are pressed together; P is its point of attachment to B, the lower jaw; F is the joint which works in a socket of the temporal bone, T. The weight is the resistance on the teeth, W. The most remarkable application of this kind of lever is found in the attachment of the muscles to the bones of the wings in birds.

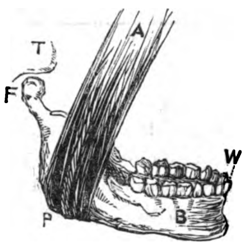


Fig. 8.

Hitherto, by aid of the poker and tongs, we have explained what are meant by *levers*, and how power was gained by their use. Returning again to the subject, let us examine a common form in which we find a lever used in mechanical instruments—such, for instance, as a watch, the principles of the construction of which I will hereafter explain to you.

You all know that there are a great many *wheels* in a watch. Each of these wheels is an *endless lever*, or rather a series of levers, connected together so as to come into operation in succession. This, Fig. 9, will explain:—F is the centre of the wheel, and the pivot is the fulcrum (F) of each of the levers, whose ends are marked A, H, D, and E. Here, then, we have a lever of the first class, represented by A, B, C, the power of which is applied at A, and the weight W supported by what corresponds to the short end of the lever, at C. If the lever A, B, C, is pressed downwards, the lever E, K, G, would take its place; and this being still pushed downwards, the levers D, C, B, and H, G, K, would come into the place of the first. The levers have been connected together by the wheel M, to prepare you to perceive the likeness between this simple form of levers and the more complicated, which is called a "cog-wheel." This is represented in Fig. 2, and is so called from the "cogs" (which are the ends of levers) on the edge of the wheel. By referring to

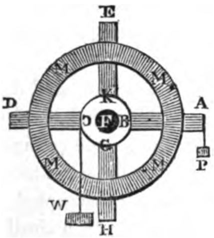


Fig. 9.

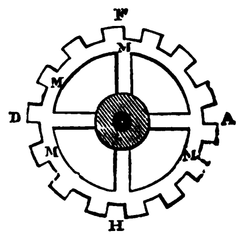


Fig. 10.

the parts (which are lettered to correspond with the preceding diagram), you will see the relation of each portion. *All wheels are endless levers.*

The wheel of the coach is a compound of levers, whose business it is to overcome the friction of the axletree; and as more power is gained by the length of the lever, so, the greater the diameter (or cross-measure) of the wheel, the less difficult it is for the horses to draw the coach. Let me impress upon you the fundamental principle that, when the power is applied to the long arm of the lever, *power* is gained, but speed is lost; while, on the contrary, when the power is applied to the short arm of the lever, speed, or velocity, is gained, and power is lost. If you give your attention for a moment to this figure, you will be able to fix this in your minds in such a manner that you will not easily forget it. You see that it is a diagram of a lever of the first class; and you will remember that I told you that a

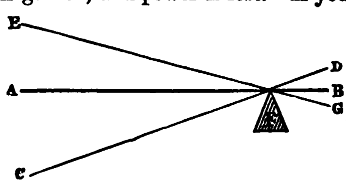


Fig. 11.

weight of one pound at A would balance a weight of four pounds at B; thus it is plain that power is gained by the one-pound weight. Suppose, however, that seven pounds raise the end A to E, the other extremity of the lever, B, will move from B to G, which is only one quarter of the distance; or, to make the fact more obvious to the eye, if we moved the long arm of the lever from E to C, the short arm would move only from G to D. As the long arm moves through four times the distance of the short one in the same time, velocity may be said to be expended or lost on the long arm, which has produced so little effect as far as speed is concerned at the other end of the lever. This experiment, reversed, would show that to move the short arm of the lever from D to G, much greater force would be required or expended, but that force would drive the long end of the lever from C to E; velocity, therefore, would be gained.

In the human foot, great velocity of motion is required; and a lever in which the power is applied to the shorter arm is the principle of its construction. This is explained in Fig 12, in which a rude outline of the bones of the foot is given, to show the mechanical principles upon which it is constructed. It is, as the diagram beneath it explains, a similar lever to those you have already seen, but it is turned upside down. A is the long end of the lever, (the toe.) F, (the shin-bone,) is the fulcrum; and B, (the heel-bone,) is the short arm of the lever. The power is the muscle of the calf of the leg P. You will be prepared now to understand what we mean when we say that for every inch which the heel-bone is raised by the muscle, the toes are depressed at least four inches—that is to say, the long arm of the lever is forced to travel four times the distance.

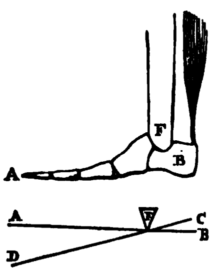


Fig. 12.

The fire-shovel reminds us that there are other important mechanical principles to be explained before we leave the fireside, namely the *wedge* and the *inclined plane*. These two are really the same; the first being a double inclined plane forced against resistance or weight, and the other being the wedge at rest while the weight is forced against it: This is explained in Fig. 13. I P, is the inclined plane, and the weight W is required to be raised from the level B, C, to the height of A. Now if

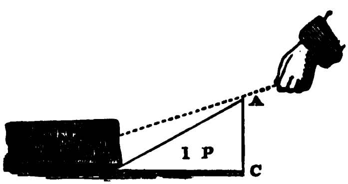


Fig. 13.

the weight is drawn up the surface A B, then we have the illustration of the use of an inclined plane, which is a wedge at rest. The shovel acts as an inclined plane when the servant pushes the ashes along its surface with a brush. But let us suppose that, instead of drawing or pushing the weight W, we strike or push the body I P, under it, the inclined plane then acts as a wedge, as does the shovel when we push it forwards under the ashes. The most powerful form of the wedge is that which is composed of two inclined planes back to back, and which, having its sharp lower edge inserted between two layers of stone or into the trunk of a tree, may be driven forward by repeated strokes of a hammer, till the edges of the slit, which at first would only admit the point A, are forced as widely apart as D is from C.

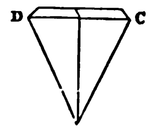
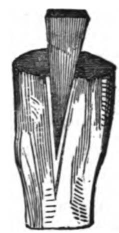


Fig. 14.

When the compression of a block of wood is completed by the means of driving in a wedge, it then splits, and it is on this principle that the action of the wedge is founded. In the annexed diagram the explanation of the law may be seen. The point of the engine has been inserted by the blow of a hammer into a block of wood, and the wood by compression, has been displaced, and the block is rending because it can suffer no more compression. All the various kinds of cutting and piercing tools, as axes, knives, scissors, nails, pins, awls, are modifications of the wedge. The angle, in these cases, is more or less acute, according to the purpose to which it is applied.



LAWS OF GRAVITATION.

To explain these laws, let us consider the draught of air which rushes up the chimney; and why the smoke goes up instead of coming down; and then from this we will go on and endeavour to explain the construction of balloons.

In the first place let us remind you of what we before explained to you, namely, that when heat is acted upon any substance, it had the effect of pushing apart the atoms or grains of which that body was composed, and making the same apparent quantity lighter. Thus a cubic foot of air being heated, so extended itself that nine parts only could be contained in a vessel which before held sixteen. We showed you that if the cold cubic foot of air weighed sixteen grains, the heated air would only weigh nine. In other words, heated air is *lighter* than cold air.

But you will be ready now to inquire—What is meant by *lightness* and weight? Why does heated air ascend, and where does it go to? In answer to these questions, I might ask others, viz.—Why does cork float in water, and why does it not go on rising, instead of stopping when it reaches the surface of the fluid? And if this cork is so light, why does it fall from the hand to the ground when we loose it from between our fingers?

We find that cork floats in water, but sinks in air; many kinds of wood which float in water sink in oil; and substances which float in oil sink in spirits of wine. Small balloons, which are so constructed as to float in air, sink in coal gas; and balloons which would float in coal gas, would sink in hydrogen gas. We are accustomed to explain this by saying that when one substance A floats in another B, that A is lighter than B. We say, for instance, that iron sinks in water, because it is heavier than that fluid, but that it floats in quicksilver, because it is lighter than that beautiful liquid metal. But this answer will not satisfy us, because we still have to inquire—Why do the lighter bodies float and the heavier sink? What are heaviness and lightness? You will perhaps reply that they are relative terms, expressing the weight of one body compared with another. But another question still arises—What is weight?

A man once sat beneath a tree, on which the ripe fruit hung ready to drop, and while he sat his musing was disturbed by the sharp crack caused by the falling of a yellow apple upon the gravel pathway close beside him. A hundred thousand such occurrences had happened before, but to those who saw them the fact had suggested nothing; the circumstance had been the falling of an apple and nothing more—to them. But the observer to whom allusion is now especially made, viewed all, even the commonest things, with the eye of one who loved wisdom;* and he immediately asked himself—Why did the apple fall? He thought over

* The term philosopher signifies "lover of wisdom." It is derived from two Greek words, both of which enter into many combinations in the English language, viz., Philo, *I love;* and sophia, *wisdom.*

this question for a long while, and reasoned upon it with the mind of a mathematician, till he learned from this common accident the principle upon which it depended. But that was not all: armed with the knowledge thus obtained, he unlocked the secrets of that "vasty deep" of blue sky in which the stars and planets have their appointed times and places. He told the inhabitants of the world that the same law, which made the apple fall; kept the globe in its place, and prevented its flying off into infinite space. The snowy moon, which sails so calmly, and holds its silent way through the far azure of the night; the solemn planets that twinkle with the light of years bygone; the comets, darting with speed electric round the sun, from the inconceivable abyss which extends behind the spangled curtain of the stars—all perform their wondrous movements, and retain their majestic permanence by the force of that same law that drew the apple to the ground. Sir Isaac Newton was the philosoper of whom I have spoken; and the power to which we have alluded, he named the ATTRACTION OF GRAVITATION.

All substances are endowed with an influence whereby they seek to draw other bodies to them. You will have observed how the soap-bubbles in a basin approach the edge and cling there. If you balance the tea-spoon upon the edge of the tea-cup, and allow the point of it to approach within a quarter of an inch of the side, you will find that the spoon will be drawn slowly in contact with the cup. If you sprinkle light dust upon the surface of a bowl of water you will find the particles rush together; and a hundred similar experiments might be shown to illustrate this principle. The larger the body the greater is the attraction exerted, and the power increases in proportion as the body acted upon is near or distant. Hence the earth upon which we live, being by far the largest and nearest object of great size, affords the most striking manifestations of this power by drawing every object to its surface, unless it is prevented by some obstacle. That other large objects act upon us is proved by the effect of the moon, which lifts upwards the waters of the ocean, and produces tides. The ebb and flow are the result of the attraction of gravitation alternately acting from the earth and the moon. Sometimes the sun and moon both draw the waters in the same direction, and then we have what are known as the high spring-tides. The waters are more easily moved than the solid parts of the earth, and therefore show more distinctly the influences which act upon them; the attraction, however, influences both.

By the attraction of gravitation we are held firmly to the earth; and without it we could not stand, or walk, or lie down, or build houses. Horses could not draw carriages, nor locomotive-engines trains. Rain would no longer be drawn to the earth, and the water of our globe would rush away as vapour into infinite space; order would cease, and chaos would be triumphant.

All bodies are acted upon by this force, and possess the power of influencing others. The air is no exception to the rule, and is drawn to the earth by terrestrial gravity. It will appear at first to be a contradiction, but it is perfectly true, nevertheless, that this attraction, which makes all the particles of air press *downwards* to the surface of the earth, is *thus* the very reason why the heated air and smoke from the fire rush upwards in the chimney. The heated air does not draw the cold air into the room; on the contrary, the cold air outside of the room, pushing itself by its greater weight through the crevices of windows and doors, thrusts the heated air up the chimney.

This may be easily proved. We have here a pair of scales upon the same principle as an ordinary weighing-machine used in shops. On either scale we have placed a tumbler which weighs exactly the same as its fellow on the other side. If, now, we pour a little water into the right hand scale, A, the left hand scale, B, rises. It rises because it is pushed upwards by the beam C of the scale, the other end of which was depressed by the increased weight of A. Or the experiment may be reversed:—the balance having been placed in exact equilibrium by placing water in both of the glasses, a straw, or small tube, may be used to suck up a little out of B, which will immediately rise, because it contains fewer particles to be acted upon by the attraction of gravitation; and it is therefore *pushed* up by A. To make the application of the experiment still more distinct, we take a glass tube shaped like a capital U, and we fit to it two pistons at either end, each of which is pressed downwards by an equal weight. Now it will be found, that immediately we remove the weight from the piston marked B, the weight of the piston A would drive the air down on that side, and push up the piston B. In the same man-

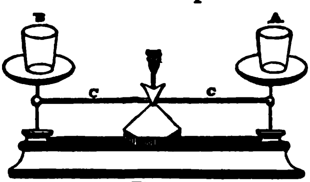


Fig. 1.

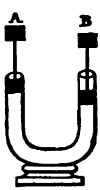


Fig. 2.

ner, the fire having heated the air in the chimney, and having thus removed the pressure downwards, destroys the balance which had previously existed, so that the cold air which presses equally in all directions with a pressure of fifteen pounds to the square inch, pushes itself into the room, and draws the heated air up the tube of brick, which we call the chimney.

If you take a spoonful of liquid tea from the cup, the space from which you took the fluid is immediately filled up; or if we bore a hole at the side of a cask full of water, the liquid rushes out horizontally; and we learn from observing these and similar facts, that the pressure of fluids and gases is equal in all directions. The cause of this is to be found in the ease with which the particles of fluids and gases move over each other. If we take a quantity of small leaden shot, which from the facility with which one pellet moves over the smooth surface of another may be said to bear some analogy to a fluid, we should endeavour to pile them into an upright column in vain, unless they were supported at the sides. In this glass (Fig. 3), we have some larger shot, so that your eye may without effort see how all bodies whose particles slip easily one over the other exert a pressure sideways as well as downwards. The shot A would fall outwards if the side of the glass was taken away. That marked B presses itself downwards between G and H, and presses them sideways; and H again presses between K and I; so that if a hole could be cut opposite the last it would be forced outwards by the weight above it. In the same manner D acts as a wedge to force aside E and F, the former of which presses against the side of the vessel which thus comes to support the weight of D. F pushes L outwards, and K acts in the same manner upon N, and through it upon O; P, Q, and R, also, in like manner, by their weight, seek to push asunder S, T, U, and V. Now, if we lifted up the shots C, F and G, D and B would immediately press underneath and fill up the space; or if X, Y, Z, were pellets of cork, on shaking the shots to make them pass over each other more freely, the surrounding pellets of lead would press underneath as wedges, and push their cork companions to the top. We have been thus particular in illustrating this point, because it explains why balloons are pushed upwards by the heavy air around them. The balloon is just in the position of the cork pellets to which we have alluded; it does not rise upwards actively, but only passively; that is to say, it does not act, but is acted upon.

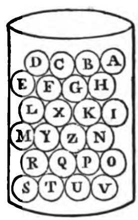


Fig. 3.

BALLOONS.

Balloons are simply bags filled with a vapour or gas; and are so constructed as to be lighter than the medium, or atmosphere, in which they float, and by which they are pressed upwards, as we explained in our last lecture to you. A common toy is sold by the glass-blowers, in which a glass balloon with car attached is made to sink or float in a column of water at the pleasure of the observer. This amusing and instructive instrument is made in the following manner:—A bubble of glass, varying in diameter from an inch to three inches, is blown and drawn out on one side to a point. The point is curved, to make a hook to which the car is fixed While the glass is yet warm, a small hole is made in the glass bubble or balloon at the point indicated in the diagram at A, Fig. 1. A car of glass is then made, of just such a weight as to allow the little glass globe, which is full of air, *barely* to sustain the weight of the whole when placed in water in a glass vessel like that represented in the sketch. The top of this vessel is covered with a sheet of Indian rubber, or with what is better, a piece of common bladder, which is tied round the rim of the top, and made quite air-tight. The apparatus is then complete. If now the covering B be pressed firmly by the fingers the balloon will descend or sink; and on the removal of the pressure it will rise again to the surface. But if the little hole (A) had not been made, no such phenomenon would have been observed.

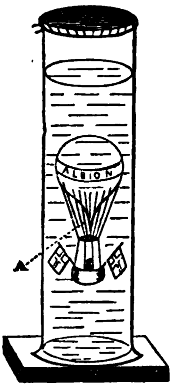


Fig. 1.

If you look very closely at the little balloon, you will perceive that it is quite *full* of air when at the top of the glass; but that when it has been caused to sink to the bottom of the glass jar, it contains a little water, which must have entered through the small hole to which we called your attention. It is plain that no air has escaped from the balloon, because when the pressure is removed from the top of the vessel the balloon is as full of air as it was before; how comes it then to happen that when the balloon is at the base of the glass it contains water as wel as air? *The air must have been pressed into smaller compass.* The fingers, pressing upon the air-tight covering, compress the air between it and the surface of the water, which latter being pressed, in turn squeezes the air in the balloon into smaller space, and thus makes room for the water. The balloon, being so constructed that a very slight addition to its weight will make it sink, then descends, because the air, being condensed, is rendered proportionately heavier, and the weight of a certain quantity of water is added to the apparatus. As soon as the pressure is removed, the elasticity of the confined air in the glass bubble enables it to resume its original size, and to push out the water which had before crept in, and the car is borne upwards again to the surface of the water. The ascent and descent depend respectively upon the condensation and expansion of the air contained in the balloon.

So much for what has been named the "water-balloon," but which might, with much more propriety, be termed the "glass-air balloon."

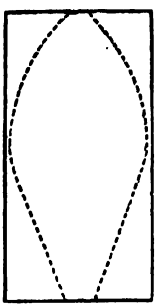
We shall now, however, pass on to speak of balloons in the ordinary sense of the word, or those well-known machines consisting of light bags inflated with gas or heated air, which, being considerably lighter than the same bulk of common air, are pushed upwards from the earth by the atmosphere with such power, as to carry up great weights attached to them in a car, or otherwise. The earliest experiments in making balloons appear to have been made about a hundred years ago, but were unsuccessful—owing to a want of care in their performance. The first persons who succeeded were Stephen and John Montgolfier, paper makers, residing near Lyons; they succeeded in raising a balloon filled with heated air in 1782. In the following year, on the fifth of June, the first public experiment was made. A huge bag of paper was filled with heated air from a stove-pipe, and to the great delight and astonishment of the spectators rose to a height of 5,000 feet. After remaining suspended for about ten minutes, it fell at the distance of a mile and a half from the place of its ascension. In this balloon there was no sustaining power, for the heated air gradually became cold, and the machine ceasing to be lighter than the atmosphere round it, could not float any longer.

It having been discovered that a gas named hydrogen (of which water is chiefly composed) was much lighter than air, it was resolved by the scientific men in France to fill a bag of silk, made air-tight with caoutchouc, with that gas, with a conviction that the machine would have a greater power of ascension than that of Montgolfier, and would possess a sustaining power, in which his balloon was deficient. The experiment was made, and was attended with complete success. Step by step improvements were made, and ascents in balloons, filled with ordinary coal-gas, or *carburetted hydrogen*, have since become common.

While the huge and expensive balloons in which æronauts now so frequently perform their perilous voyages are beyond the means of, and are not required by ordinary students of philosophy, smaller ones may be contrived to illustrate the principles upon which the larger are constructed. The crop or craw of the turkey, if cleaned and carefully prepared, makes a very light bag, which will ascend when inflated with dry hydrogen: but the membrane is not easily procured and prepared; and, we shall, therefore, proceed to tell you how simply to construct a paper balloon upon similar principles to those by which the first was made.

FIRE BALLOONS.

COMMON fire-balloons are constructed in the following manner:—

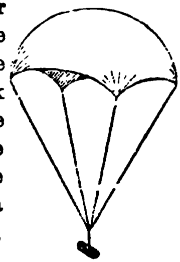


Paste two sheets of tissue paper together by their narrowest edges, and having prepared twelve such pieces (24 sheets in all), lay them aside to dry. From each of the double sheets so prepared, cut out a form like that indicated by the dotted lines in the annexed diagram. If the edges of these are overlaid each other, and pasted, a globe will be formed, opened at the top and bottom; the aperture above is to be covered in by a circular piece of tissue paper overlying the ends of the segments which form the sides, and at the lower aperture a circle of bonnet-wire must be attached by turning in and pasting round it the lower edges of the paper segments. A cross wire, to which is fastened a piece of sponge, or cotton-wool, must then be placed across the aperture, and the paper balloon is complete.

PARACHUTES.

THE word Parachute is derived from the French, and is composed of two terms, signifying, a guard against falling *(parer chute)*. It is an apparatus somewhat resembling the common umbrella, but of much greater size. It was intended to enable an aeronaut (or air-sailor), in case of alarm, to drop from his balloon to the ground without sustaining injury. When the parachute is detached from the balloon, and abandoned with its little car and contents to the atmosphere, its top is expanded by the air through which it rushes, and the machine descends with comparative slowness to the earth.

A model of a parachute upon a small scale may be made by any of you, without much trouble. Take a square piece of cap, or tissue paper, and to each of the corners attach a piece of thread twice as long as the paper is broad. Tie the ends of the strings evenly in a knot together, and affix to the knot a cork of moderate size. Let the whole be dropped from an upper window, and you will see the paper expand, and that its resistance will allow the piece of cork to come only slowly to the earth. As a contrast, it will be worth while to drop a piece of cork, *without* the paper, out of the window at the same time, to observe how much more rapidly it will come to the ground. This will be found a very interesting experiment.



WATER.

We shall first speak to you of the *composition* of water.

Have you ever observed, that when a lamp or the gas is first lighted, a sort of dew hangs for a moment upon the glass, and then disappears? This is water. If you hold over a candle a tube of some length, and take care to keep the stem (*b*) very cool, you will thereby condense the vapour which passes along, which will be found to drop as a fluid from the end (*a*). The stem is kept cool to absorb the latent heat of the vapour which arises from the candle, and which has derived its warmth from the combustion going on in the flame. *The fluid is nearly pure water.* It absorbs, in condensing, a little of the carbonic acid gas, which is formed by the burning of the candle. But whence

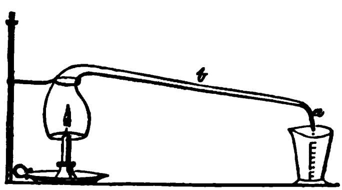


Fig. 1.

comes the water? However strange it may appear—the flame produced it. Pure carbon, uniting with oxygen, produces a red heat only; some other gas is therefore present when flame is seen. Moreover, carbon and oxygen by their union do not form water; we are thus led to suspect that the water produced by the flame of the candle must depend upon some gas before unknown to us. How shall we prove this? Availing ourselves of the fact that what is called galvanic electricity has the power to decompose bodies through which it passes, let us try if we cannot separate the component parts of water. We have here what is called a galvanic battery, and as we do not like to show you any instrument without explaining its construction, we shall digress for a moment, to tell you the manner in which it is made. The outside vessel (A) is a copper cylinder, which is filled with a very strong solution of what is known in the shops as "blue vitriol;" but the proper name of which is *sulphate of copper*, being a compound of sulphuric acid and copper. On the inside of this is a sort of shelf full of holes (D), upon which we have placed a number of pieces of the substance just alluded to, with a view to keep the solution as strong as possible. Within this again is a cylinder of porous material which contains a mixture consisting of one part of oil of vitriol, and seven of water. In the centre of this is a rod of zinc (C), supported in the smaller cylinder by the cross piece (I). The instrument is fitted up with caps and screws (E and F), to connect the wires (G and H) along which the current of electricity passes from the battery. If the end of these wires (G and H) be brought together, a spark will be seen to pass between their points; or if they are held in the hands (previously wetted), the peculiar effects of a continuous current of electricity will be felt.

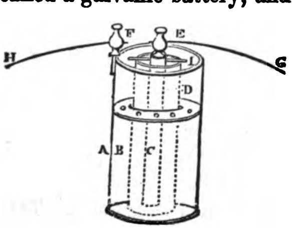


Fig. 2.

To make the phenomenon of the decomposition of water very evident, several of these batteries should be connected together. The wires connecting the two ends of the batteries should also be waxed over their whole extent, except about an inch at the points, so that when they are plunged in the water which is to be decomposed, a tumbler, or other glass receiver, may catch all the bubbles that rise. If this arrangement is made, and the wires plunged into pure water, a stream of gas will rise in bubbles from each wire where it is uncovered by the wax. These bubbles are produced by the wires from any good battery, but unless the stream of galvanic electricity is powerful, the gases are not produced in sufficient quantity for examination. The gases from each wire having been collected, let us proceed to test them separately. A taper plunged into the first burns with increased brightness; but in the second, is immediately extinguished, though the gas itself at the moment takes fire itself. The first, we may be pretty sure, is oxygen, as the great supporter of combustion; and the latter, being an inflammable gas, is our new acquaintance—hydrogen.

Perhaps you still are in doubt, however, that these two gases are the only materials of which water is made up or entirely composed. We have here a glass tube which contains a mixture of these two gases, oxygen and hydrogen, and which has two pieces of wire which go through the sides, and whose points nearly meet in the hollow part inside. In the curve of the tube (*c*) there is some water, which has been previously measured exactly, and which is placed there to prevent the gas in the hollow part at *a* being mixed with air. If we now connect the wires of the battery with the wires which pass through the gases, an explosion will take place, and the oxygen and hydrogen will have united again in the form of water. If quicksilver is placed in the tube the experiment is still more striking. As, however, the explosion is violent, the experiment is fraught with some danger.

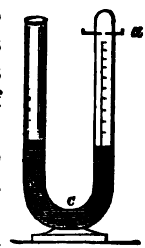


Fig. 3.

There are other methods for decomposing water which are more easily practised than that which we have described to you, and which we will now show you how to perform.

Let an ordinary half-pint bottle be rather more than half filled with water, and drop some pieces of zinc or iron turnings into it; then pour in about an ounce of sulphuric acid, or vitriol. A bubbling and hissing will immediately commence, and a quantity of hydrogen will escape. If a cork with a small tube passing through it be fitted to the neck, the stream of gas may be lighted, and will be found to burn with a very pale blue flame; and if the tube represented in Fig. 1 be held over it, water will be found to result.

Another method of decomposing water is by passing the steam from a kettle through a gun barrel full of iron-filings made red-hot in a chafer, or portable furnace. In this experiment the oxygen of the steam (vapour of water) is attracted and absorbed by the heated iron, and pure hydrogen passes out at the other end of the gun barrel, where it may be collected and burned. In the burning, the hydrogen again combines with the oxygen of the air, and water is again produced.

This experiment will be made more interesting if all the materials are exactly weighed before the boiling is commenced, which will enable the operator to discover if any loss or destruction of matter has taken place. When such an examination is made, it is found that some of the water has vanished, and that in consequence, the vessel containing it weighs less than it did before. Whither has it flown? On weighing the gun-barrel, an increase of weight is detected, proving that something has been added to its contents; and upon emptying out the iron-turnings, which were put in so bright and clean, we find that a brown coating has destroyed their metallic lustre, and increased their heaviness. If this extra weight be added to the weight of the hydrogen which has passed off, it will be found to make up a sum equal to the weight of water missed from the kettle or boiler. By chemical analysis the brown coating upon the iron shavings should be proved to be composed of the metal united with oxygen in the form of *oxide*, which is the name used to describe the results of all such unions of the gas with metals. If, moreover, the oxygen could be liberated from the iron, and made to unite with the hydrogen which has passed over, the exact quantity of water which has been missed from the kettle would be reproduced.

This union of oxygen and hydrogen may be effected by pressure, but the gases, in uniting, produce a violent explosion, and therefore the experiment should never be performed except with instruments constructed to allow of this sudden expansion of the contents. To this explosive property of a mixture of these gases, the fire-damp of coal-mines owes its destructive powers; and to the same cause is due the accidents which occur when the ordinary coal gas escapes into cellars, and becomes mixed with the air, in which it finds oxygen. Hydrogen alone has no explosive propensities, unless it finds some oxygen with which to come in contact and unite; and in like manner the carburetted hydrogen, which is used to illuminate our streets, would have never produced the accidents recorded, in its pure state. An electric spark passed through pure hydrogen does not ignite it.

On the other hand, wherever we see a flame, we may be sure that hydrogen is therein, combining with oxygen, and that water is being produced just as it is by the candle or gas-light.

Hydrogen is quite colourless, transparent as the air, but fourteen times as light; it is therefore peculiarly adapted for floating heavy weights in the atmosphere when confined in a bag called a balloon. It does not support combustion, though it is itself highly combustible—a burning spark immersed in it is immediately extinguished.

Next to oxygen, hydrogen may be regarded as the most important constituent of the earth. It takes its name from two Greek words, the former signifying "water," and the latter "to produce." It is evolved from the earth by volcanoes, and forms various combinations, among which may be mentioned *ammonia*, the essential principle of the common smelling salts. It is said to be breathed out by certain plants, of the fungus or mushroom class. But most important of all the phenomena connected with it, is its strong affinity for oxygen, and the formation of water, of which hydrogen—light as it is—constitutes more than a tenth part by weight.

As it does not support combustion, you will be prepared to hear that it cannot support respiration, which is the same phenomenon in a different mode. Nevertheless, though hydrogen does not support life, it can, unlike carbonic acid, be breathed for a few seconds. If we speak while the chest is thus filled with the gas, a remarkable alteration is perceived in the tone of the voice, which becomes softer, shriller, and often squeaking. When wind instruments are played with it their tones are affected in a similar manner.

If the surface of the planet which we call the world was divided into ten equal parts, it would be found that seven of those parts were occupied by water, which is believed to be, in many places, about four miles deep.

When we look around us upon nature, we find that everything is exactly adapted to its purpose; and hence, when we find that water is more bountifully given to us than any other thing, we may safely agree that it *must* be the most essential. Without doubt this is the fact, although it is probable that we know as yet but a very few of the important purposes to which it can be applied. Without water we should have to dispense with many of those cooking operations which produce the most nutritious food: for example, by boiling, we transform the poisonous tuber of potatoes into a most valuable article of diet. Without water, where would have been the gigantic engines which seem almost to annihilate space, and twine the threads that, under the influence of peaceful commerce, shall bind the hearts of all people in friendly union together? Without water—the seed could not spring, the leaf expand, the flower bloom, or the fruit swell. Without water—the blood of man could no longer leap along his blood-vessels, and carry life into his limbs, nor the work of digestion or nutrition be accomplished. Without water—this exquisite elastic robe of skin which covers our bodies would dry up, and cease to perform those numerous functions which, if not absolutely necessary to life, are at least essential to comfort and well-being. Without water—man's eye would lose its brilliant lustre, its crystal transparency, and that power of rapid motion which is so marvellous in its changing glances. Without water—his tongue would shrivel in his parched mouth, and no longer retain the sense of taste, or its faculty of expression—speech. Without water—his nostrils would lose their sense of smell; and his ear would be unable to convey to his delighted brain the music of sweet sounds. Without water—life itself would cease to be—the rainbow would no longer span the heavens—the earth would be a dusty barren blank—and the sky a cloudless grey!

THE SEASONS.

We need hardly tell you, dear boys, that the earth is a globe, which, with many others, revolves or rolls through space around the sun, which is another great globe surrounded by a fiery air or atmosphere. The earth upon which we live is eight thousand miles in diameter.

Although all seems so fixed and still in the heavens and earth, the globe which we inhabit is whirling onwards round the sun at the rate of nineteen miles in a second. The highest ordinary speed attained by a railway train is thirty-five miles an hour—twice that speed would be *seventy* miles an hour, and would be considered dangerous; but the earth is rolling through space at nearly *seventy thousand* miles an hour. Nor is this all its motion. If a person could be lifted above the earth and its atmosphere, and could occupy a fixed position, from which he could observe the motions of the planet on which we live, he would not only detect the motion to which we have called your attention, but he would find the globe turning round, like an apple suspended from a twisted string, and the surface of the earth would be exposed to his eye at the rate of a thousand miles an hour! This rotation, or turning round of the world upon its own centre, is the cause of day and night, while the journey which the earth performs round the sun produces the changes of temperature and light which we call the seasons—Spring, Summer, Autumn, Winter.

The earth is not perfectly round like a shot, or cannon ball, but is flattened on two opposite sides like an orange. From these flattened sides, if the earth had had an axis, or pivot, on which it turned, the ends of such pivot would protrude; and hence these points of the earth are denominated north and south *poles*, from the Greek word signifying a pivot, or axle-tree. The stalk-mark on an orange, and its blossom-mark, correspond to these localities on the earth's surface. To understand this and other matters, let us take an orange (which makes an excellent representation of the earth), and pass a thread with a knot on the end through the marks above alluded to, then the knot will represent the south pole *b*, the thread in the body of the orange the imaginary axis of the globe, and the point at which the thread comes out the north pole *a*. Having placed a candle near the centre of the table, to represent the sun, set the orange twirling on the string, and walk round the table, always keeping the orange towards the light. You have then an imperfect representation of the motion of the earth on its own axis, and its movement round the sun. Now place a white wafer on the orange at the point O in the centre, and observe the different degrees of light which it derives as the orange turns on its axis, and the changes which correspond to our day and night.

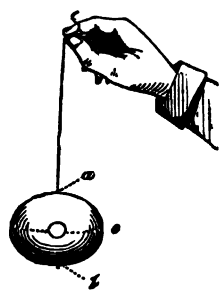


Fig. 1.

To give you an idea of the mode in which the phenomena of the seasons are produced, and why those periods bear certain characteristics, we must explain that the course described by the earth is not *exactly* a circle, and that the axis of the earth *is not upright*, with reference to the sun, like the axis of the orange in our illustration. In describing the illustration, we purposely directed that the candle should not be in the centre of the table, because the sun does not occupy what would be called the centre of the course of the earth. We have here a sketch of the earth's orbit, which is not circular, but *elliptical*, or of the shape called an *ellipse*. The sun is represented at S, and the earth at various points of its annual circuit; *a* shows the position of the earth in winter; *b* that at the spring equinox (equal night and day); *c* represents the position of our globe in summer; and *d* at the autumnal equinox. The line passing through the centre of the earth represents its imaginary axis, while the lines across the poles are intended to show the regions of perpetual snow near the two poles. When the earth is at *a*, the whole of this division near the North Pole (N P) is in shade, the nights being several months in duration in the arctic regions, while during the same period it is summer at the South Pole (S P), where the sun does not pass below the horizon for a similar period. At *b* and at *d* there is equal day and night; while at *c* the South Pole is entirely in shade, while the earth turns completely round, and the North Pole is as entirely in light. This is the summer of the northern hemisphere, or half-sphere, in which is England. It seems odd that our summer should occur at that time of the year when the earth is farthest from the sun, and that we should have winter when our globe is nearest; but you will soon understand this if you observe that when the North Pole is towards the sun, as at *c*, the rays of the sun shine upon us almost perpendicularly, and that the days being long, the earth has time to get warmed by them; while at *a*, on the contrary, the North Pole is turned away from the sun, and consequently the rays of heat fall upon us in the northern hemisphere obliquely; the days also are short and the nights long, so that the surface of the northern hemisphere has little time to get warm.

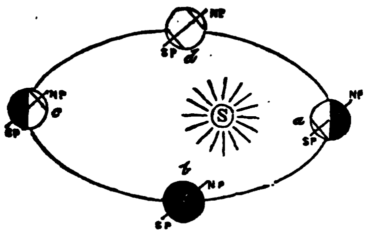


Fig. 2.

We will now instruct you how to form a good illustration of the seasons, from which you may obtain a clear comprehension of the varying positions of the earth, as regards the sun and the results.

Place a candle a little on one side of the centre of a round table, and having passed a thread through another orange, let Tom take the one, and George the other. Into each orange push a pin, so that the head only may appear in the same position occupied by Britain on the globe. Now let George stand upon a chair, and hold his orange by its thread so as to make it hang about a yard directly above the edge of the table nearest the light. George's orange will thus represent the position of the earth in the winter of the northern hemisphere, and as it turns, will show you how very little of the candle-light the pin's head obtains. Hence you will understand why the days in winter are so short and the nights so long. On the opposite side of the light, let Tom hold the thread of his orange so that the fruit shall hang only about an inch above the edge of the table, and you will then see that though his orange

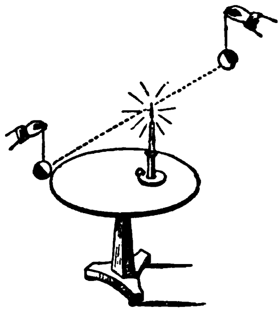


Fig. 3.

is farthest from the candle, yet that the northern part of it is in possession of the full and direct rays, and that the pin's head has only a very little shade to pass through as the orange turns round. Tom's orange represents the position of the earth in England's summer. If John and little Joe take their positions on either side between Tom and George, and hold their oranges over the edge of the table, level with the flame of the candle, they will respectively be representations of Autumn and Spring. Owing to the fact that we are so much nearer the sun in winter than in summer, his orb appears larger at noon in January than in June.

Let us now review the year we last passed through, and note the changes which are produced by a passage of sixty-eight thousand miles round the sun. In January we experience cold, which we explained to you was the absence of heat, and which congealed the vapour of water in the air into snow and ice. Then we saw the vapour of the cloud changed into solid matter by losing its latent heat: and afterwards, when a fresh supply of heat was given, the solid ice absorbed it, and became the fluid water. Hence we learned from Winter, that the same substance may be solid, fluid, or gaseous, in proportion to the degree of heat to which it is exposed. In April and May, when Spring had come, we experienced changing temperature, which, condensing the vapour of the clouds into water, produced frequent showers, which were again dried up—the water being converted into vapour—by sunshine, and the winds of March. We saw the seeds which had been planted spring and grow under the influence of moisture and warmth, and thence might learn that heat and water were necessary to the germination of seeds. Then sunny

Summer came, and with its recollection come pictures of leafy scenes and gorgeous blossomings of flowers.

We learned in our Summer walks that each plant purified, under the influence of summer light, the air we breathe; and that the vegetable creation, which was so beautiful to the eye, was likewise so necessary to our life, that without it we should be suffocated. We saw, too, that, under the influence of summer heat, the seeds which we afterwards gathered in Autumn were perfected, and that the warmth and light of the sun were necessary to their complete formation.

In Summer, too, we saw the streams dry up, and the roads become dusty; and from thence again deduce the inference that water is evaporated, or converted into vapour rapidly by the sun's heat. This change of water into vapour lessened the oppressive warmth, and made the neighbourhood of rivers cool and refreshing. With Autumn came the harvest, supplying food to man and beast, or, in other words, affording to him the materials with which to repair the constant wear and tear of the animal machinery, and fuel to keep up during the winter the slow fire which is burning within him, and which is called animal heat. Hailstorms, or showers of frozen rain-drops, proved that currents of cold air were floating above us, and freezing the contents of the clouds. The leaves having performed their offices, dropped from the boughs, and manured the earth, to ensure its fruitfulness in the distant Spring. And Winter has come round again, and with him frost and snow. Animals, in the mean time, have shed their summer clothing, and assumed a thicker garb of hair, fur, down, or other non-conducting covering, to prevent the warmth of their bodies being carried off. The air being condensed, the lungs receive a larger quantity of oxygen, and give off a larger amount of carbonic acid; and an increased quantity of animal heat is thus produced, to enable them to bear the inclemencies of the season. The cold changes the water which has sunk through the surface of the earth into ice, and in doing so, splits the lumps in which the moisture lay hidden, converting them into fine mould, or soil, suited for the seeds of Spring. Over all is often spread the white garment of snow, which, like the fur clothes of the Esquimaux, protects, by its non-conducting properties, the vegetation from the intenser cold of winter winds.

As far as we can judge with our limited vision, every year brings fresh increase of fruits and herbs for our use and for the support of the animals upon which we are dependent; each year sees improved and extended cultivation. Where lately the voice of man was almost unknown, and where dark forests had grown for ages, undisturbed by the axe or the plough, happy homesteads and broad fields extend. Are we, my dear boys, profiting by the moral to be deduced from all this? You are in the spring-time of your life—sow the seeds of truth without delay. Go out into the uncultivated portions of your own intellect, and cut down the forests of ignorance that prevent truth from taking root and growing there. Leave no portion of your minds unploughed. But while you cultivate your intellect, do not forget the affections—the heart. Wisdom will do little without goodness.

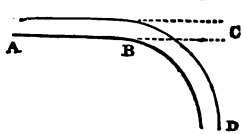
CENTRIFUGAL FORCE.

Let us now stop to inquire how it is the law of gravity, which *tends* everlastingly to draw the lesser planets to the greater ones, does not rather interfere with order, and produce the chaos which would result if this tendency was unopposed. How is it that our comparatively little globe, being continually attracted to the vast mass of the star around which it revolves, is yet never dragged from its orbit, and hurled into the sun? Why does the pale moon continue her silver walk athwart "the floor of heaven so thick inlaid with patines of bright gold," though she is ever courted by our planet to leave her path among the stars, and to descend to earth by the attraction of the latter? What keeps the stars apart? and why, in giddy and confused race, do they not obey the force which ever acts upon them, and draws them to each other?

We will endeavour to answer these questions by directing your attention to some common and every-day occurrences, in which we shall find a law that is universal and sublime in its operation. The other day, when George came in with his cap covered with snow, he whirled it round at arm's length, and straightway the flakes of frozen vapour were driven off. When Peggy trundles the mop, she gives a rapid twirling movement to the ends of the fibres of woollen at the head of it, and forthwith the particles of water and dirt which are entangled among them fly off all around. We dare say you have seen at some of the fairs (happily these pernicious amusements are fast fading away) the "roundabouts" on which young people like yourselves are foolish enough to sit. We mention them, not for the sake of advising you never to subject yourselves to the giddiness and sickness which is produced by riding upon them; but to point out to you the manner in which the boys are continually in danger of falling *outwards* or from the centre, especially if the machine is driven too fast. If a man on horseback does not lean inwards when he rides quickly round a corner, he will be thrown from his saddle by some force which pushes him outwards. What is this force? —this influence? If, while your top is spinning, you will let fall some grains of sand or crumbs of bread upon its surface, you will notice that they are thrown off as soon as they touch it. The same influence appears to be at work, moreover, when the rapidly-revolving wheels of the carriages throw the mud into the air; and the same force makes the sparks from the grindstone fly from the wheel. When you stir your cup of tea, the fluid being pressed from the centre by this mysterious agency—rises at the side, and if the liquid be made to revolve very rapidly, it will flow over the brim. You may learn from grinders, that this force is not unfrequently strong enough to make the stones which they use fly to pieces, if they are caused to rotate too rapidly; and in like manner, the great fly-wheels of steam-engines, which make their motion continuous, have been broken by the power which constantly drives the parts of revolving bodies from their centres. This force, moreover, acts upon the earth as it revolves round the sun, and tends to cause the world to fly off into infinite space, and to drive from the centre of the earth all substances imposed upon it. We see by your whispering, that you are now prepared to solve the enigma, and to answer the questions proposed to you. The attraction of gravitation is opposed by the *centrifugal* force we are describing to you. The word centrifugal is derived from two Latin words, signifying centre-flying. The attraction of gravitation would draw all the planets into the sun, while the centrifugal force would send us flying into infinite space. These two are equally balanced; and by their exact adaptation, the stability of the planetary system is maintained.

The centrifugal force bears an exact relation to the force of gravity; that is, the heaviest bodies (other circumstances being equal) have the greatest centrifugal force. It moreover increases with the rapidity of motion. The heaviest planets being endowed with the greatest attraction for the sun, thus have given to them at the same time a proportionate counteracting impulse. Yet so just is the balance depending upon the rapidity of the planet's motion, that should any cause permanently diminish the rapidity of its elliptical journey round the central orb, the lesser mass would be immediately drawn from its orbit into the sun!

You may ask why this liability to fly off from the centre is produced in rotating bodies? and, in answer, we must explain to you another phenomenon in physics, namely, that all bodies in motion, or at rest, have a tendency to continue in the same state. Thus, though it may require considerable effort to move a carriage, it demands comparatively little force to keep it in motion; and, moreover, when the vehicle is stirred, it cannot be stopped without a shock. When a railroad train is on its way, any check to its speed throws all the passengers forwards towards the engine, because the bodies of the people had a tendency to continue to go forwards at the same speed as that of the carriage. As this constantly occurs, it is held to be a mechanical law, that bodies in motion will continue to move in the same direction *for ever* unless checked by some opposing force, or influenced by a new impulse. When next you are travelling on the iron path, observe what happens when the carriage comes to a curve in the line. Suppose the train to be passing along the railway, (the direction of which is indicated in the diagram by the letters A B D,) as soon as it comes from A to the point B, the tendency of the mass, passengers and all, is to go on in the direction of the dotted lines towards C, and you and your fellow-travellers will be pressed outwards. This tendency, which is called *momentum*, and the centrifugal force, are therefore identical. At every portion of a circle, through which any body rotates, the force which is manifested at the commencement of the railway curve is exerted.

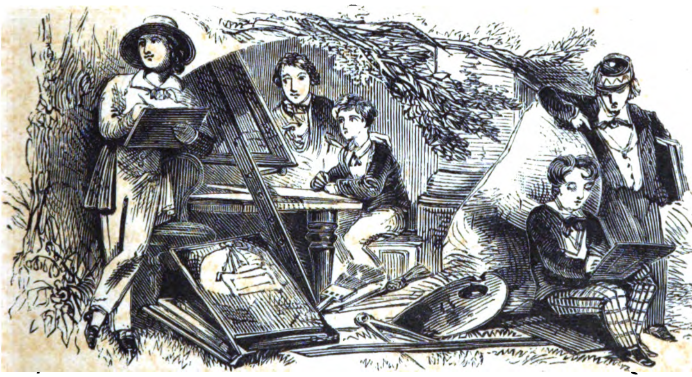


But some of you will, perhaps, inquire what is meant when we say that it is an inherent quality of matter to remain for ever in motion or at rest; and will tell us that a cannon-ball, if fired into the air, where it appears to encounter no resistance, will shortly lose its rapidity, and gradually come to the earth. Besides the resistance afforded by the air, there is also the attraction of gravitation, which, by dragging the ball downwards, brings it in contact with the surface of the earth. On the other hand, the huge spheres which whirl around the sun and planets have no such obstacles to contend with, inasmuch as they circulate through an empty void, and are prevented by the balance of gravitation, and the centrifugal force, from forsaking their spheres, and thus coming in contact with their companion orbs in the heavens.

An experiment to illustrate the effects of the centrifugal force may be performed as follows:—On the surface of a large bowl of water float a soup-plate, or smaller bowl, and give the latter a rapid rotary motion with the fingers, and, while the motion continues, drop some large shot upon the plate; you will observe, that the shot will at once be driven from the centre. If you pour water upon the plate, moreover, you will observe that a similar effect is produced, and that the fluid rushes immediately to the rim of the plate.

If George will fasten to the end of a piece of string a ball of wood, and whirl it round his head, he will find that the string is tightened by the desire which the ball seems to have to fly from his hand, which is the centre; but a greater force will be exercised, if, in the room of a ball of wood he use one of lead; he will observe, also, that the force becomes greater as the rapidity of motion is increased.

THE ILLUSTRATED BOYS' OWN TREASURY OF



DRAWING.

PRACTICAL LESSONS IN DRAWING.

First Lesson.—*The necessary materials* for commencing pencil drawing will be a sharp penknife; three black-lead pencils, marked H.B, F, and B; and some drawing paper, or cartridge-paper, or a drawing paper book. We advise our readers to use cartridge paper to begin with, and to have it cut into sheets, which should be numbered at the upper right-hand corner, and when finished deposited in a box or strong portfolio.

To cut your Pencil properly.—As you cannot draw until your pencils are cut, we must request you to cut them, not like *b* in (Fig. 1,) which is hacked; but cut it to a point like *a*, (Fig. 1.) In cutting it properly you must not remove too much of the wood, but only sufficient to expose a small part of the lead; if too much of the lead is exposed it will break.

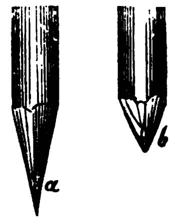


Fig. 1.

Position during drawing.—It is of great importance that the student should sit to draw in a proper position. Do not have a low table, which obliges you to poke your nose almost upon the paper, and press your chest against the edge of the drawing desk; but sit in an easy, upright position, with your feet straight before you, the left hand resting upon the edge of your paper so as to keep it steady; the copy *before* you and *nearly upright*, and the sheet of paper upon which you are to draw slightly elevated.

The proper position to hold your pencil should be that the ends of the fingers are about an inch and a half from the point; and the pencil should not be held *too tight*, the elbow being kept well in towards the side, but not too stiff; by this means you will have perfect freedom of the hand, and complete command of the pencil.

As you are now prepared to commence your drawing, please seat yourself properly at the table, and make an effort to form *straight* horizontal lines, like *a* (Fig. 2), and observe that they are to be parallel, and at equal distances from one another. When you have succeeded in drawing a dozen of these lines the size of the copy, you should then try to form some twice the length and then go on, increasing the length of them, until you are able to draw lines a yard in length with a piece of chalk upon a black board.

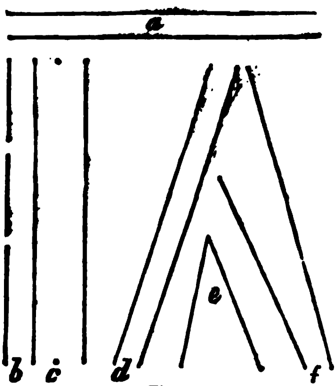


Fig. 2.

To draw horizontal straight lines.—First make a dot upon the paper where you are to commence, and another where the line is to terminate (as *c*, Fig. 2), then draw a line, between the two, from left to right, the same as between these two points.

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Continue to do this until you are able to draw the lines straight and horizontal; then practise making perpendicular lines.

To draw perpendicular straight lines; proceed the same way as if drawing horizontal lines; that is, by making dots or points first, and commence with short lines, like the upper one of *b* (Fig. 2.). Then increase the length, until they double and quadruple the original ones.

When you have succeeded in drawing either horizontal or perpendicular straight lines, repeat the exercises with the different pencils, so as to give greater breadth to some lines than to others; and sometimes draw the lines very close together, at other times very wide apart, and afterwards fill up the intervening spaces with lines. By this means you will acquire a correct eye and idea of the rudiments of form and proportion.

To draw oblique lines, you should place the dots upon the paper as usual, and practise forming lines from right to left (as *d*, Fig. 2), and afterwards from left to right (as *f*, Fig. 2). When you have acquired sufficient command of your pencil to form the various lines correctly, quickly, and freely, join two of them together, so as to appear like *e* (Fig. 2.)

Draw the lines whether they be oblique or slanting, perpendicular or upright, and horizontal, or in a line with the floor, in every kind of manner, sometimes beginning at the right hand side and sometimes at the left; at one time at the top of the line, at another at the bottom of it. Do this, practise often, strive to overcome all obstacles, and depend upon it you will accomplish wonders.

Second Lesson.—As you have learned to draw straight lines parallel to one another, it will be necessary to make you connect them in some way, so as to form the outline of an object.

Draw two straight lines parallel to one another (like *a* in Fig. 3); then connect the ends of them by a small curved line, and from that draw a short perpendicular and a short horizontal line (as *b* in Fig. 3); repeat, until the outline of a set of steps is complete.

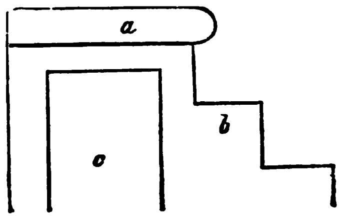


Fig. 3.

Draw a horizontal straight line, and from either extremity of it draw two perpendicular straight lines (as in c, Fig 3).

Draw two oblique lines, so that their lower extremities shall meet (as *a*, Fig. 4). Then draw two parallel straight lines, so that the beginning of the upper one shall be almost immediately over the end of the lower one, and join the ends of these lines with oblique lines (as *b*, in Fig. 4).

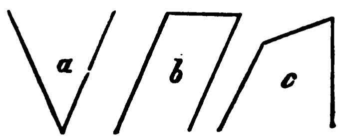


Fig. 4.

Draw a perpendicular straight line, and from the upper end of it, an oblique line from right to left, then unite the end of the oblique line to another oblique line (as in *c*, Fig. 4).

Draw a perpendicular line, and from the lower part of it draw a horizontal line from right to left, (as *b*, in Fig. 5.)

Draw four horizontal lines, and then join their extremities by four perpendicular lines, (as in *a*, Fig. 5). This will represent a block of wood (called a *cube* in geometry), having six faces, and eight corners or angles, like a die.

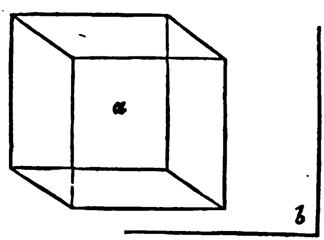


Fig. 5.

Here is another geometrical figure which you are requested to copy. To do so correctly, begin by making two dots and then forming the upper line; then calculate that the distance of the second line is twice the depth of the fore part of the stone (which is represented in Fig. 6),

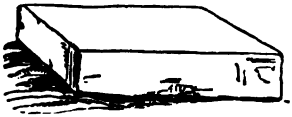


Fig. 6.

and draw a *very faint short* stroke to fix the distance. You must now fix the place to commence the second line, and you therefore place a dot at about the same depth as the forepart of the stone towards the right and another dot at about one and a-half of the depth from the right of the end of the upper line; then draw a line between the two dots. Join the ends of these two lines by oblique lines, as represented in the figure above, and proceeding in the same manner to place dots upon the paper for the other parts, draw the short perpendicular lines and the oblique and horizontal lines. The figure is now complete in outline, and you must therefore finish it by the addition of a few strokes and dots as shown in the figure.

To form the outline of the figure, use a F pencil, and a HB to fill in the other strokes.

Here is another figure that you must practice frequently, because it will give you a fair knowledge of the combination of form and proportion and will school your eyes to the perspective of solids. In this, as in all cases, proceed by making dots before you commence drawing your lines; and we merely repeat this again because we wish our pupils to understand most distinctly *that no line should be drawn until the length of it has been marked upon the paper by dots.* When you have drawn the upper horizontal line (of *a*, in Fig. 7), draw a perpendicular line from

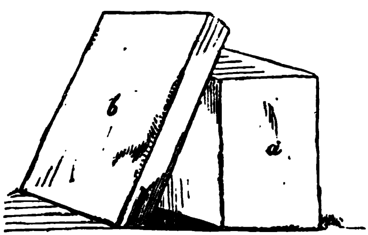


Fig. 7.

each end of it, and let each of these lines be one and a half the length of the horizontal line; then unite the two lower ends of the perpendicular lines. Now draw a faint horizontal line along the base of *a*, and at about half the height of the oblong *a* place a dot on the faint horizontal line, and another dot at rather more than a third of the length of the dot just placed upon the line from the left lower angle of the oblong. You must then place a dot at about half the length of the above distance above the horizontal line and the same distance from the second dot as the width of the base *a*. From these several dots, draw oblique lines, (as in *b*, Fig. 7), and join them by other lines as shown in the figure. You must now draw other short lines from the oblique ones to the face of the oblong, and finish the figure by a few short strokes at the base, as shown in the above figure.

It is required to represent the two sides of a pyramid. Draw two faint horizontal lines *b c*, and another one *a*, perpendicular to them, then draw a line from *c* to *b*, commencing at the place where *a* cuts *c*; then draw another line from *c* to *b*, one-third longer than the line on the right of *a*, commencing at the point of junction between *a* and *c*. Place a dot on the left of the perpendicular *a*, at nearly the same distance from it, as the space between the lines *b* and *c*, and twice the length of the oblique line on the right of its base, between the line *c b*. From this point or dot, draw lines to meet those drawn before, and the figure will be complete.

Draw a horizontal line, *a b*, and then draw a perpendicular line, *c d*, across it (as in Fig. 9).

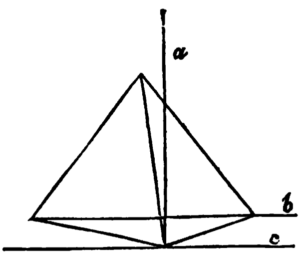


Fig. 8.

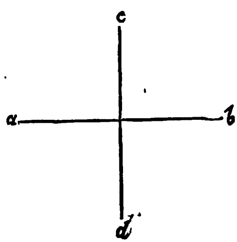


Fig. 9.

You will have formed four right angles *a e c*, *c e b*, *b e d*, *d e a*; but we are not going to study angles now; that is not our object. We wish you to notice our remarks and practice the figure; then when you can draw this well, you should draw the lines in different directions so near that *c* may be brought nearer to *b*, and *d* to *a*; by this means you will form various kinds of angles.

THIRD LESSON.—You must now turn your attention to the drawing of curved lines. Unless you can draw a curved line accurately, in any direction, you can never hope to delineate the human figure or animals in a proper manner; for the outlines of both the animal and vegetable kingdoms are made up of curved lines of every variety. It is needless to give a long list of examples; the student will easily observe them in the objects around him, from the horse to the cat or diminutive mouse; or from the gay butterfly that soars above him, to the caterpillar, from which it has been transformed; or from the lofty oak to the humble acorn.

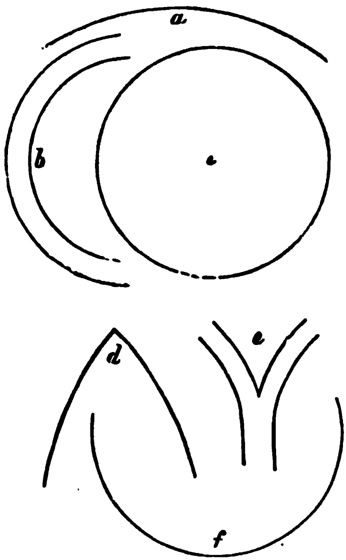


Fig. 10.

Commence practising the formation of curved lines, by drawing several like (*a* Fig. 10.), and then, when you are able to do so accurately and easily, draw parallel lines with greater curve, as (*b* Fig. 10). When you can enlarge these copies upon a black board, with a piece of chalk, or reduce them with a pencil upon paper, then you may venture to draw a circle like (*c*, Fig. 10).

To draw a Circle.—Perhaps one of the most difficult tasks for the beginner is to draw a circle; but like everything else, it is easily done when you know how to set about it. Commence the task by making a faint dot upon the paper to mark the centre; then place a another dot on either side of it and at equal distances, and continue placing dots at equal distances all round the central one, until a circle of dots is formed; you must then join all the dots with a steady and slow sweep of the hand, beginning at the top of the circle, and drawing from left to right, and right round from the point at which you started. Practise this several times as it will give you precision, and enable you to observe the relative distance of the outer part of the circle from the centre. Do not attempt to use compasses to draw a circle. They will not assist you; on the contrary, when you are without them, you will be at a loss, and unable to accomplish your object. Persevere and practise continually, and your labours will be rewarded.

When you have drawn a few dozen circles by the aid of the dots, draw some without making any marks upon the paper or board; sometimes drawing from left to right, and at other times from right to left.

Draw one circle within another, so that their margins shall be parallel, as in the portion of one shown in *b* Fig. 10.

Draw a semicircle, (as *f* in Fig. 10), and then practise forming *d* and *e* in the same figure, until you can *join lines* neatly, sometimes commencing from the lower part of the figures, and at other times, from the upper part.

Divide circles into sections, so as to exhibit the half, a quarter, a third, or other divisions of a circle.

Draw squares, polygons, and triangles within circles, and then construct a circle within a square.

Copy the following figure, and then proceed to draw the three following outlines, which you will no doubt do correctly and readily, from the practice you have already had in the curved lines. Be careful in copying *a* and *c*, to make the left hand lines darker than those to the right, while *b* has lines of each breadth. It is well to use the pencil marked H B for this purpose, the different thicknesses of the line being produced by the degrees of pressure employed.

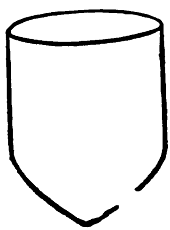


Fig. 11.

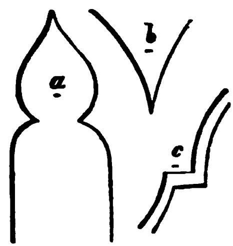


Fig. 12.

FOURTH LESSON. In drawing lines, the hand should rest upon the two last fingers,—if the lines are short the motion of the hand should not extend beyond the wrist joint; but if the lines are long, then the hand will glide over the paper easily, if it is carefully balanced and rests upon these fingers, while the motion of the hand proceeds from the elbow or from the shoulder.

As you have already practised curved lines and circles, you will no doubt be able to copy this example which is the outline of the volute of an Ionic capital from the Erictheum, at Athens. It is needless to describe how it should be drawn, because if you have attended to the rules already given, you will be able to know to proceed at once. Copy this example over and over again, enlarging and diminishing the copy, until

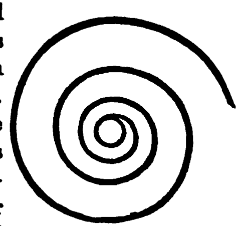


Fig. 13.

your eye has become familiar with the figure; then endeavour to form its outline without having the example before you. When you have accomplished your task, you will be better prepared to copy the next example.

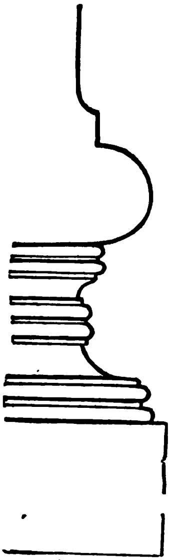


Fig. 14.

This drawing is a combination of curved and straight lines, so arranged that they form the outline of the base of a column, and by copying this example frequently, you will acquire a very good idea of proportion. If you had not exercised yourself in drawing straight and curved lines, you could not have drawn this figure. You may, therefore, look upon straight and curved lines as the letters or alphabet of drawing.

Here is another example, composed of straight and curved lines, but differently arranged. In drawing this, commence by making a *faint* horizontal line upon the paper; then place a dot at a proper distance above, for the centre part of the arch; from this dot draw the right hand curved line until it meets the horizontal one, then place another dot a little above the horizontal line, at nearly the same distance as the height of the arch from it, and draw two parallel curved lines close together, from the top of the first curved line to the dot you have just placed on the paper. You have now formed the outline of the arch.

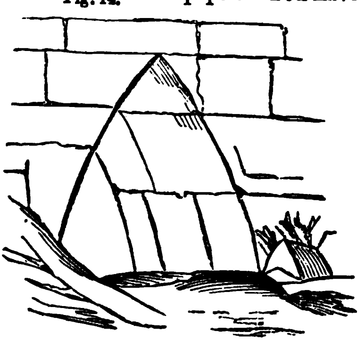


Fig. 15.

Draw a horizontal line from each side of the top of the arch, and at the respective distances draw other lines parallel to it; then draw perpendicular lines between the horizontal ones, and you will now have formed the masonry. Sketch in the lines of the two banks, commencing with the left one, and afterwards sketch in the stones on the right of the base of the arch. At rather more than half the length of the left-hand curved lines place a dot, and another, at about two-thirds the distance from the base of the right-hand curved line; connect these two dots by a curved line, and then sketch in the masonry of the archway, as in the example; all that now remains for you to do is to fill in the shading, which is done by making short parallel strokes at equal distances from each other, as in the example before you.

The next object that you are required to copy, is a pyramid, and you observe that the first example is sketched only in outline, in order that you may clearly understand how it is done.

When you have drawn the outline correctly several times, you may

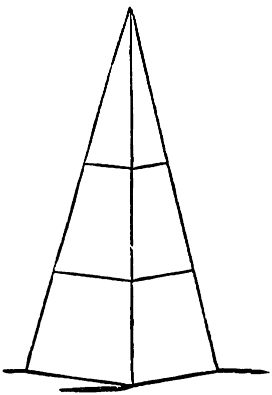


Fig. 16.

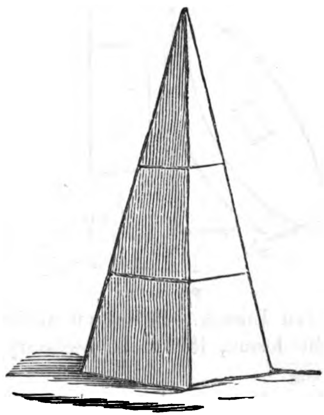


Fig. 17.

commence the next example (Fig. 17) which you observe, is carefully shaded by drawing fine perpendicular parallel lines between the transverse lines, and all of them at equal distances. The shading at the base is drawn in a similar manner; the only difference being that the lines are horizontal, instead of perpendicular.

The next example is the outline of a pillar with a millstone resting against it (Fig. 18); and when you have sketched this, it must be filled in, the same as the other example (Fig. 19), which shows the same objects shaded, according to the method we have already pointed out. The weeds and grass require a few extra touches with an HB pencil, and the outline should be strengthened in the dark parts.

Practise these examples frequently, particularly the weeds at the top of the pillar, and the shading.

When you are able to draw these examples as they are represented here, draw them backwards; in other words, place the millstone on the right instead of the left of the pillar.

Draw examples 17 and 19, and shade them as if the light was on the left.

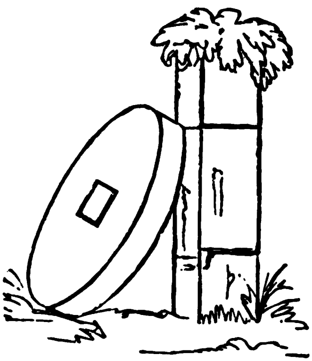


Fig. 18.

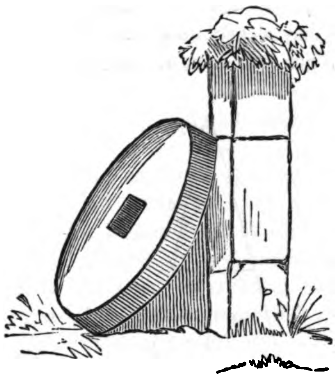


Fig. 19.

Fifth Lesson.—Before submitting the examples we have prepare for this lesson, it will be necessary to make a few observations upon copying.

We will suppose that you have to copy a drawing,—perhaps an architectural one. How would you commence? Most probably differently to your neighbour, who would also commence differently to his neighbour, and so on, unless guided by correct principles. Do not imagine that what we state is without foundation, it is perfectly true; for, not long since, we placed two drawings of the same subject before four pupils, and requested them to copy them, and each one commenced differently. One of them began at the right-hand side, the other at the left, another at the top, and the fourth in the centre of the drawing. What could illustrate more forcibly than these blunders, that attention to the rules of the art is *absolutely necessary?*

You ask, "How am I to commence?" and to this question we will at once reply. First, enclose a certain space, by means of four lines, if for a landscape; or by an oval or circular line, if for a portrait, &c.: this is called the *the boundary line of the drawing*, and is used to confine a certain portion of a landscape or other subject. The importance of attending to this rule will be obvious to every person; and when we treat hereafter of sketching from Nature, you will then find how essential it is to adopt this method. When the boundary-line is formed, your next care should be to determine the relative positions of the principal objects. points, or features, &c.; and if you have attended to the instructions given in the former lessons, you will not have much difficulty in doing so by faint lines and dots. In a landscape you will have to fix the height of the horizon, which should be done by first placing a dot at each side of the boundary-line, and then, if you have judged the distance correctly, uniting the two by a faint line drawn through the picture; this is called *the horizontal line*. When that has been done determine the nearest *conspicuous* object to the boundary line, its height,

Fig. 20.

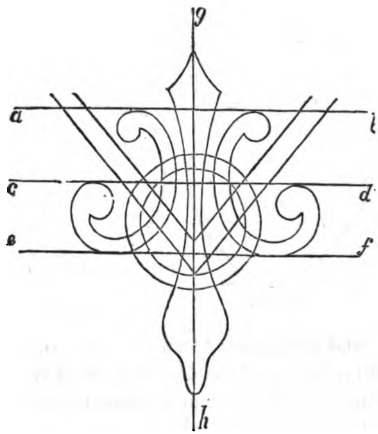


Fig. 21.

width, and relative position to the horizontal line, and other objects; then fix the position of the trees, distance, and foreground, by means of faint outlines, or dots, or both, taking care to observe their relative situations, inclinations, and measurements are regulated by their proximity to the boundary, horizontal, and base lines of the picture; the last-mentioned line, being the bottom or lower boundary line of the drawing.

In Fig. 8, you were directed to draw a line perpendicular to the horizontal ones, this was done for the purpose of enabling you to judge the relative distances of the several angles of the pyramid from each other, and you will find it very useful to draw a line through the centre of any object that you have to copy, because it serves as a guide to the proper disposition of the several other parts. Of course, as you become more and more proficient in the art, *this will not be always necessary.*

We will now commence some practical illustrations of the preceding remarks. You are required to draw Fig. 20, which is a centre-piece for a border, or an ornamental panel. Fig. 21, is a diagram illustrating the method of doing so, which is thus: First draw three horizontal lines, *a b*, *c d*, *e f*, and bisect them with the perpendicular line *g h*. You have only to determine the relative distances of each point by means of dots, and to draw the curved and straight lines faintly, as shown in Fig.

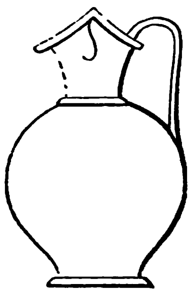


Fig. 22.

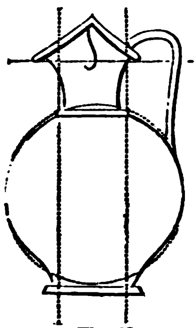


Fig. 23.

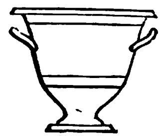


Fig. 24.

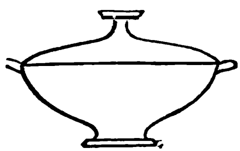


Fig. 25.

21, and afterwards to rub out the superfluous lines, and strengthen the outline by broad touches with an H B pencil.

We have found it an excellent plan to cut the Indian-rubber, used for rubbing out architectural and fine drawing, in a triangular shape, because the angles enable us to remove very small lines, or dots. The Indian-rubber should not be more than 1-4th to 3-7ths of an inch thick.

Our next example is of a different character, being the outline of an antique vase (Fig. 22). In drawing this figure, a circle is first of all drawn, and then it is divided by two perpendicular lines, (as shown in Fig. 23), and a horizontal line drawn above the circle. These lines are sufficient to enable the pupil to construct the figure with ease.

Our next exercises are taken from antique vases, and given without any diagrammatic illustrations to enable the pupil to construct them; because, having already given ample directions, we wish our pupils to think for themselves, so as to be able to act at times without the aid of an instructor.

Fig. 26. The Quoit-thrower

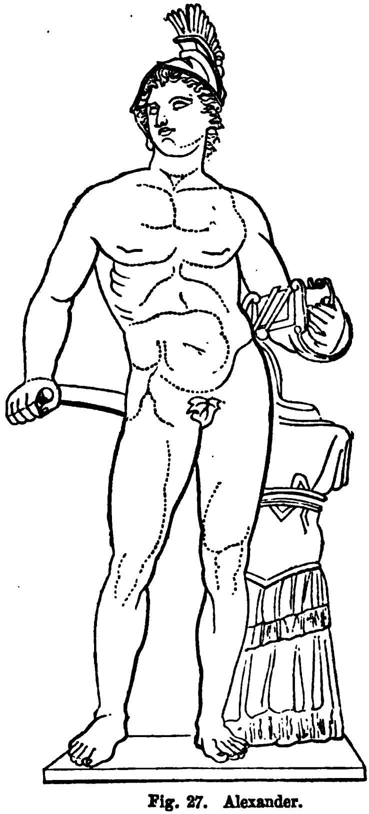


Fig. 27. Alexander.

SIXTH LESSON.—We have now to consider the subject of "Outline," a most important one to a draughtsman.

A simple perfect outline is more valuable than an imperfect one, worked up with all the skill of a Vandyke, Wilkie, or Landseer.

Many persons assert that the shading and filling up will hide some of the defects in a bad outline; but be assured that such advice is not only wrong, but highly injurious to tyros in the art of drawing; for opinions such as this are apt to undermine its right principles, and make beginners careless.

Outline signifies the contour, or the line by which any figure is defined, being, in fact, the extreme or boundary line of an object. It is the line that determines form. For example—the outline of an apple, would not, if correct, convey an impression to your mind that it was intended for an orange or a pear; and if you look at Figs. 22, 24, and 25, you could not imagine that they were like the ordinary jugs in use.

Outline may be said to be the skeleton or anatomy of objects; at least it bears the same relations to them.

Outline cannot be formed without the aid of curved and straight lines, (see Lesson III.), and in illustration of this, we beg to call the attention of our pupils particularly to Figs. 26 and 27. The former represents the statue of the quoit-thrower of Myron, and the latter the statue of Alexander, by Gabius, after that of Lysippus, in the Louvre. They are both admirable studies for outline, particularly the latter, which exhibit gracefulness, courage, and strength, the muscles being admirably expressed without the aid of shading.

Fig. 28. Pysche

Of course, as you are now able to form lines of all kinds, in any direction, and of any reasonable length, you are already in possession of the alphabet of outline, and the rest depends upon yourself—for without constant application and attention you can never succeed.

Never be absurd enough to delude yourself, while you think you are deceiving your relations or friends, *by tracing outlines against a window.* The practice cannot be too highly condemned, because it is contrary to art, honour, and good sense; and so long as you continue the system, it will be impossible for you to depend upon yourself.

All marks of lines that assist in expressing the character of the design, may be considered as belonging to outline.

There are many methods of producing effects by means of outline, besides adhering to variations of form in the figures. For example—the lines used to express drapery should be flowing, continuous, and generally of variable breadth; those used for the flesh or for some kind of fruit should partake of the same character; hard substances, such as armour, statuary, &c., should be expressed by uniform lines of a fine character; and the foliage should be drawn boldly, with occasional dark touches, and with a tremulous lateral motion of the hand. The figure of Pysche, will assist the pupil in comprehending our remarks upon drapery and flesh.

Never jag your lines by making them by fits and starts; let the motion of your hand be free and uninterrupted, so as to form a continuous line; for if the pencil is removed from the paper, a line like a saw will be the result.

We need not remind our pupils that there are extremes of outline as in other things; the one is too great a uniformity of line, the other too great a variation of breath of line. If the subject is intended to be *finished* in outline, the pupil should strengthen one side more than the other; and we recommend that the outline etchings issued by the "Art Union of London," which are excellent compositions, should be carefully studied and copied.

If the subject is to be shaded, the outline should be lightly, and not too firmly, drawn.

We must remind the student in drawing, that to give a correct delineation of the human figure it is indispensable to have some knowledge of muscular action. It is necessary that all the muscles, their purposes, and functions, should be well understood; nor must osteology, or the bones of the skeleton, be neglected.

SEVENTH LESSON.—As you are now able to draw outlines correctly, it will be necessary to study light, shade and reflection, which will give the appearance of substance to the objects you wish to delineate.

If we consider light as applied to drawing, we must do so under four distinct heads,—1st, as *natural light*, or that emanating from the sun when it rises,—

> "At morning, flinging wide
> Its curtain-clouds of purple and vermilion,
> Dispensing life and *light* on every side;"

2nd, as *artificial light*, or that derived from combustible bodies; 3rd, as *direct light*, or that light which reaches an object directly, without passing through or being reflected from one object upon another; and 4th, *reflected light*, or that light which, when it is received by one object, is thrown off or reflected upon another, as from glass or water.

However, we must request our pupils to try some *simple experiments* for themselves with regard to light before they enter upon their drawing-lesson of light and shade.

Place a cork upon the table in front of your window, and let its end rest upon a sheet of paper. You will observe a pyramidical *dark shadow*, the base of which commences at the cork, and also a pyramidical *faint shadow*, the apex or point of which corresponds with the base of the dark shadow; and you will also observe that a portion of the cork is *faintly*, another portion *deeply*, and another portion *semi*-shadowed.

Place the cork upon its side, and you will obtain nearly the same results; but with this difference, that the shadows are broader, and the effect produced less striking.

Substitute a billiard-ball, a marble, or a bullet for the cork, and the effect is nearly the same, only that the shadow is elliptical, or somewhat oval, instead of pyramidical.

Roll up a piece of paper so as to form a cone, gum down one of the corners, and cut off the base, so as to be even; then set this upon a piece of paper, and you will obtain the same shadows as when you employed the cork, which may be easily proved by placing them side by side.

Many similar and simple objects will readily suggest themselves to the pupil, and should be used as familiar examples to practise light and shade.

From what you have seen, it will be evident that all opaque or non-transparent objects, upon which light happens to fall, must be partially in shadow, whether the light falling upon them be reflected, natural or artificial; while other parts will be illuminated; and therefore placed in strong contrast with those parts of the object that are in shadow.

SHADING is intended to impart the appearance of solidity to objects, so that the amount of depth of shading in a drawing conveys the idea to the mind of the beholder—1st, that the object delineated is in relief, or projects from those surrounding it; 2nd, as regards the relative position of one object with regard to another; and 3rd, the distinctive distances of objects from the person viewing them.

Shadows are either natuıal or accidental. *Natural shadows* are those that the lover of nature beholds as he rambles through the lone copse, the tangled wood, or river's margin, where

> "The barks at anchor cast their lengthened *shades*
> On the gray bastioned walls."

Those who aspire to be artists—nay, even the timid amateur, content to toil over the well-beaten path that thousands have journeyed over before—must ever be on the alert to gather studies from nature, as

> "The shades of evening softly creep"

over the gentle slopes where innocent lambs feed, or frisking kids nip the tender grass; nor must they despise the lessons furnished by many a quickset edge or ruined wall, over which

> "Some trees
> Whose massy outline of reposing shade"

seem placed to tempt the artist to linger on his journey and take a sketch. We have several lovely sketches of what artists term "bits," snatched in haste from many a bright spot where we have rested in our rambles, even as the

> "Shadows, nursed by Night, retire,"

or the sun's bright beams were first welcomed by returning morn. These each convey lessons—pleasing lessons—not only of artistic but of religious instruction, which gushes forth as we view their beauties. To enjoy such thoughts, to sketch such views, and to treasure up their lessons, we must leave the busy haunts of men, and freed from care and toil, and noise, seat ourselves beneath the umbrageous arms of some ancient tree, and gaze upon

> "A surface dappled o'er with shadows, flung
> From many a brooding cloud."

If a ball is placed upon the table, and a ray of light is allowed to fall upon it, the side near to the light will appear different from the other part upon which the light does not fall, as may be seen in Fig. 29, in which A represents the point from which the ray of light proceeds until it falls upon part of the ball, *d e*, which thus receives direct light, while the other part (*c*) is in natural shadow or shade. You will also observe that there is a long pyramidical shadow thrown upon the table, the result of the non-transparency of the ball.

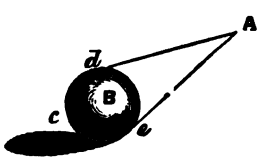


Fig. 29.

Having directed your attention to the preliminary and important points connected with light and shade, it now becomes necessary to make some observations upon shading.

In shading there are three kinds of manipulation requisite—1st, waving; 2nd, stippling; and 3rd, cross-hatching. There are certain rules connected with shading which must be generally observed; for it will be found that much of the appearance of objects depends upon the shading employed; for it is by means of the kind of lines used that the projection of bodies from one another, and the appearance of the materials of which they are constructed, are conveyed to those who only possess the opportunity of viewing the sketch. Colour is at all times better adapted to depict the skies, portraits, &c., than drawings of uniform tint, however well the latter may be executed.

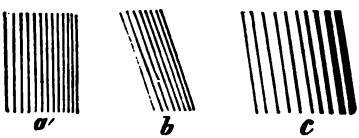


Fig. 30.

The strokes used in shading may be of uniform thickness or not, and they may also be placed at regular or irregular distances. If of uniform thickness (as *a*, Fig. 30), they give the same tone to a drawing that one colour would, if it were placed upon the paper; but if the same strokes are drawn closer together in one part of the drawing than in the other (as *a*, Fig. 30), then that part will have a deeper tone. The same result holds good with respect to oblique lines (as in *b*, Fig. 30). If the lines become darker or broader, and nearer to each other as they recede from the light, then they will convey the impression of an increased depth of tone (as in *c*, Fig. 30), whether the lines be oblique, perpendicular, or horizontal. All lines used in shading do not take the same direction, as, in addition to those mentioned above, some are semi-circular.

Fig. 31.

Here is a figure (Fig. 31) that combines outline and shading, and forms an excellent study for the beginner in both, as in the former lesson, it serves to illustrate the beauty and grace of curved lines, and in the latter, of uniformity of shading.

Waving shading is produced by a succession of strokes close together, by using a soft pencil (F or B) with a worn point. If these lines are made with a fine-pointed pencil, there is not a uniformity of tint produced, and therefore the lines should not overlap one another, but be drawn as in Fig. 32. Foregrounds and deeply-cast shadows, broken earth, &c., require this kind of shading.

Fig. 32.

Stippling consists of a series of dots, which impart a depth or lightness of shade, just as they are made large or small, or closer or farther apart; the general rule being to make the large and close together in the depth of the shade, and gradually small and wider apart as the light is approached.

Cross-hatching is produced by drawing a number of lines in such a manner that they cross one another at right angles. They should always be commenced from the outline as in Fig. 33, and one direction of lines finished before the other cross them; otherwise unevenness of tone will be produced. They should always be thinner as they approach the light, and also wider apart. In curved objects it is necessary to observe the relative convexity and concavity of the surfaces, and to represent them by lines exhibiting a greater or lesser curvature, taking care to increase their breadth in certain parts, and diminish them in others, as may be seen in the most common engraving of concave or convex objects.

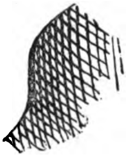


Fig. 33.

The general rule for shading is, that flat surfaces must be represented by straight lines; convex and concave surfaces by curved lines, as in Fig. 34, which represents a ball, and shows the manner of increasing the depth of tone by drawing the lines closer to each other; and all surfaces of a mixed appearance must be dealt with according to circumstances; some parts requiring curved and other straight lines, while others again will require cross-hatched lines both curved and straight.

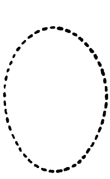
Remember that much of the perfection of shading consists in the knowledge of how much you can do, and no more, and how much your pencil will do.

Fig. 34.

In order to attain perfection or even mediocrity in this department of drawing, you should practise strokes of every description, with each kind of pencil, upon sheets of paper, marked at the top thus—H: H.H.; H.H.H.: &c., and practise with fine-pointed and worn-pointed pencils, sometimes plain, at other times curved, and also cross-hatched strokes. By this means you will ascertain the power of your hand, and the tone of your pencil.

ART IN SPORT.

An almost endless source of amusement, combining at the same time a considerable amount of instruction may be obtained in the following manner. Take a card or piece of pasteboard, or even stiff paper, such as cartridge paper, and draw upon it the form of an egg—an oval in outline. The dimensions of the oval are immaterial, and the experimenter may suit his own fancy in this respect. With a stout needle, or tracing point, prick quite through the outline, for the purposes of tracing. Having pricked out the oval upon the card, get a little red or black lead, powdered, and, placing the card on a piece of drawing paper,—any white paper will, however, do,—rub it over the pricked-out oval, which will be found to be transferred to the white paper beneath, thus:



The powder may be applied either with a piece of wool or wadding, or by means of a dry camel's-hair pencil: care should be taken not to let the tracing-powder get beyond the edge of the pricked card, as in that case a soiled, dirty appearance is given to the tracing. The pierced card will serve, if carefully done, for hundreds of tracings, and it is obviously the best plan to take a little extra pains with that in the first instance.

With this traced oval for a basis, [a little further on we shall speak of other figures, to be used singly or in combination with each other,] any one with a very little skill will be able to form an infinite number of objects.

The best drawing tool will be found to be an ordinary black-lead pencil.

Figs. 1, 2, 3, 4, 5, 6 are very easy results, suggestive also of others. The rules of procedure are the same in all. Leaving the traced-out oval at first in its dotted form, with the pencil you draw a horizontal line, as the basis of your figure. Let this and the other lines, which serve

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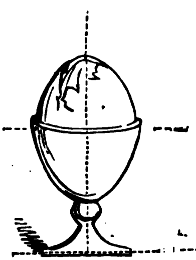

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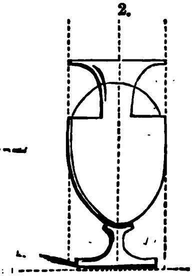

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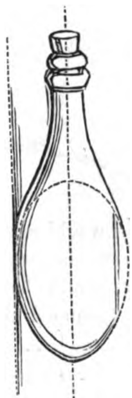

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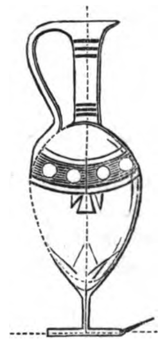
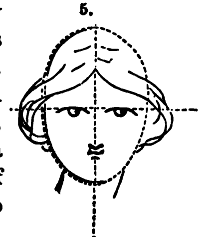


merely as the scaffolding of your figure, be done faintly or in dots. Next, draw a line through the centre of the oval, and perpendicular to the first. These will ensure your making the object square and properly balanced. After this you may draw lines parallel to the others; but these are not so material, although they serve as guides.

Now the imagination and fancy may step in to produce forms having the oval for a foundation; and not only is a very rational source of amusement opened out, but the opportunity is given to a cultivation of the noble art of design, whether as applied to utility or ornament.

5.



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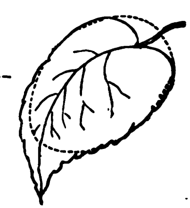

Following the same plan in every particular, we subjoin some examples of what may be done with the square.

The dotted lines (Figs. 7, 8) represent the traced or sketched square and plain lines; the firmer lines suggest objects formed upon that figure. In the same way the thin square outline (Fig. 9) suggests the inner sketch of a church.

We stated before that the size of the fundamental oval or square made

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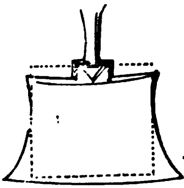

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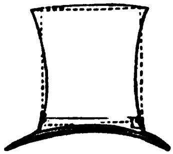

9.

little difference; but we would recommend our younger readers to get these as large as possible, or convenient. If a large black board, such as is used in most schools, could be obtained, and the tracings prepared proportionately large (pounded chalk being used instead of the black or

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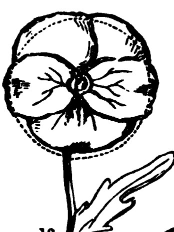

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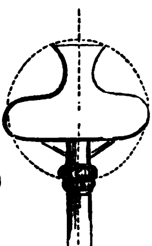

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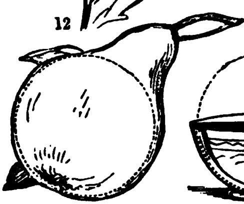

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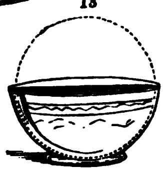

red powder in transferring the forms thereto), and the designs made upon these with a piece of chalk, so much the better. However, this matters little, and each boy will suit his own taste in that respect. We now proceed to submit some examples of what may be done with other rudimentary forms.

Following the instructions previously given, in place of the square suggested in Figs. 7, 8, 9, describe a circle. This may be done with a pair of compasses, or simply sketched or traced by means of any round object, such as a coin laid flat upon the paper. Figs. 10, 11, 12, 13, 14, 15, are given merely as suggestions, the circle forming an important part of their figure. The mind of the experimenter will immediately revert to other objects—thousands such are to be met with around us—having the circle or the sphere for their basis. And it will be no mean result of these papers, if any number of our young readers are led thereby to a habit of observation, whereby they will not fail to notice that nearly all natural objects have the curved line for a basis, if they are not actually distinguishable thereby from those that are artificial.

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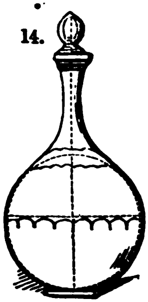

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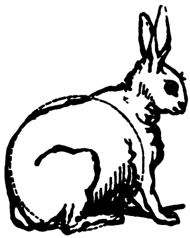

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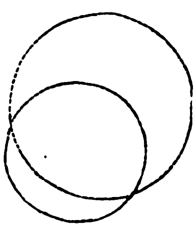
Fig. 16 is drawn upon two circles in combination with each other. The dotted lines of the plan will be readily perceived; but lest there should be any difficulty, they have been drawn separately in Fig 17.

17



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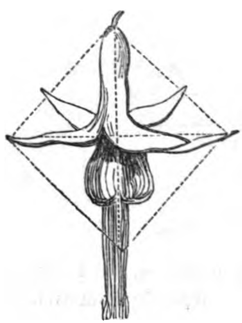

With this duplex figure little skill will be required to present the lord of the farmyard. The three outlines, Figs. 18, 19, 20, re based upon the square turned diamond-wise, and will need no further remark: examples upon this plan may be multiplied easily. Those

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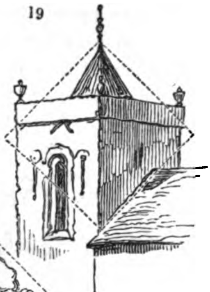

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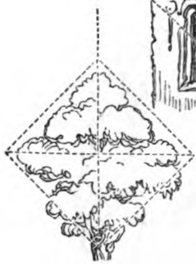


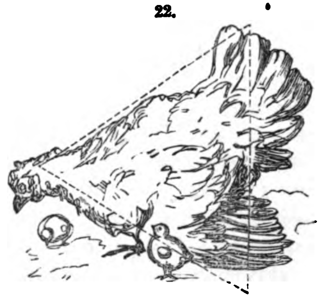
given will serve as hints in the several directions of flowers, and foliage, landscapes generally.

Before proceeding to show what may easily be done by a simple combination of the figures we have constructed, *i. e.*, the oval, square, and circle, let me introduce another, which enters, by a kind of natural law, into almost all forms or groups of forms, namely, the triangle. Observe in the annexed cut, Fig. 21, how naturally, although unconsciously the girl seats herself within one.

A moment's reflection will show, that from the little nymph in the cut to the great pyramid, everything that rests solidly upon the earth must take the form, more or less, of this broad-based tapering figure. Roofs

21.

22.



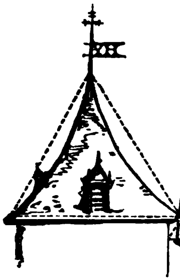
of houses, churches, and towers, are all triangular in their form, as are all great trees differing from each other only in the width of their angles.

Construct a triangle,* and trace it according to former directions, and

* This is done easily enough, but the following directions may not be needless for some. Draw a straight line for a base of any length. If you wish to form a rectangular triangle, *i. e.*, one of which the three sides are equal, divide this base line by two, and at the point of division set up an upright line; then from each end let

from the examples, Figs. 22, 23, 24, look around you for others, and make various exercises upon this foundation.

23.



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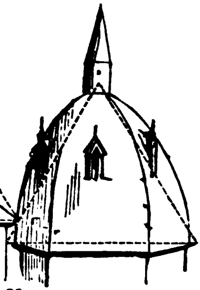

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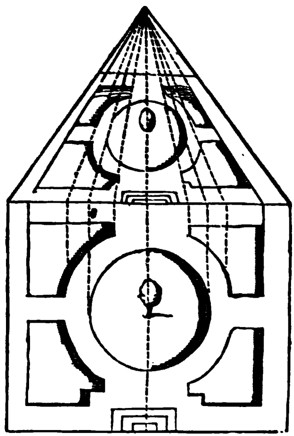
A



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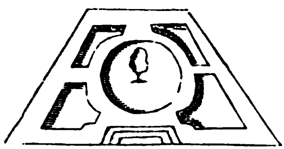

Now, to proceed to something more complicated. Suppose you had either in your mind, or sketched out upon paper, the plan of a garden; that is to say, suppose you had the dimensions of a piece of ground, and intending to lay it out as a garden, allotting so much space to this and that bed, so much to gravel walks, and wanted to see how such an arrangement would look in perspective,—in other words, in reality, for perspective, however alarming it may look in books, with its net-work of lines, cross and across, like an insoluble riddle or a monster cobweb, is nothing more than the actual representation of things as they meet the eye.

Let your plan be what is shown in the square portion of Fig. 25; at the top of this plan place your triangle, draw a line through the centre of the square upwards, until it meets the top A of the triangle. Next draw

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the base line slant against the central upright line one the length of the base. These, of course, will meet at the top, and the triangle is formed. Any other triangle may be formed in a similar manner, the length of the sides being at the choice of the young artist.

lines from the corner of the beds parallel to the central line until they meet the base line of the triangle. From thence continue all these lines to the point A. These give you the width of the beds *in perspective*. The other sides of their figure may be easily enough found. Fig. 26 is the perspective view sought, and is what your experimental drawing would be if, having done the plan and guide-lines in pencil and the rest in pen and ink, you had erased the former with a piece of india-rubber.

We do not know whether our young readers regard the matter in the same light, but it appears to us that this little figure—the triangle—is capable of working wonders, if only properly used.

Is the annexed cut any exaggeration of the average sort of result attained, not only amongst very juvenile experimenters, but with those of a maturer age?

27

It may be asked, How would the foregoing rules, with what are to follow, affect the case?—In this way.

Everybody possessed of vision can tell, ordinarily, whether a building or other object is upright, or in the position proper to it or necessary to its stability. By accustoming the hand to form lines, ovals, circles, squares, and triangles, and by habituating the mind to form comparisons between objects, and these and other figures, a person is put imperceptibly, as it were, in the way of depicting them with accuracy.

It may be safely assumed, that no boy who had followed up even so far as this series of articles, would have made such a drawing as is shown in Fig. 27.

To proceed—let us take the above misrepresented country residence, and applying to it the previously given rules, see what we can make of it. We would first draw or trace the parallelogram* shown in dotted lines; over this, we place a triangle; then drawing an upright line

* Any four-sided figure whose lines are parallel to each other is so styled.

through the centre of both, make that the base of another and lengthened triangle, as shown (see Fig. 28). Thus we get the three lines of the

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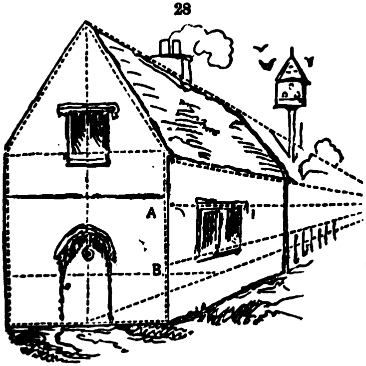

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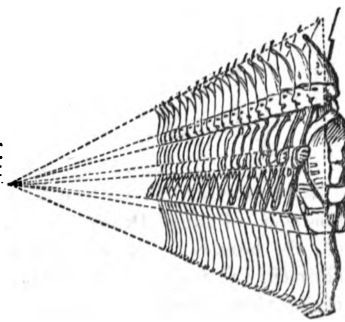
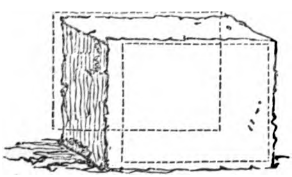


side and roofs; and if we knew the proportionate height of the side window, by marking the same at *a b*, and carrying lines from those points to the apex of the side triangle, we get its true perspective dimensions.

The difference between the two results is as great as possible.

In Fig. 29 the triangle placed at the side of the soldier in front gives (by rules before-mentioned) the perspective of the whole line.

30



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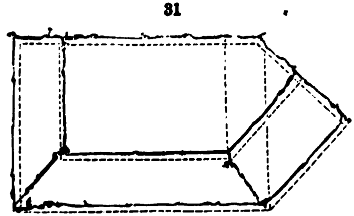


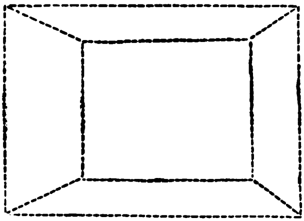
Fig. 30 shows how two parallelograms in combination assist in giving the perspective of a block of stone or bale of goods.

Fig. 31 exhibits the parallelogram and triangle in combination.

Perhaps nothing is more puzzling to the tyro in sketching than the nteriors of rooms and halls. In Fig. 32 a very easy method is given. Trace the outer parallelogram, and within it, a smaller one, then connect the corners of the two as shown in the cut.

Fig. 33 is the application of the preceding.

32



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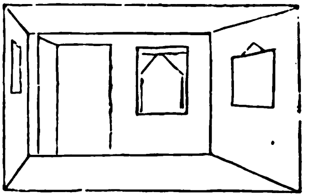
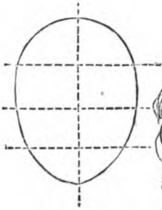


We now intend to let you into a great secret, the secret, namely, of Comic or "Funny" Drawing,—a method, in fact, which is at the bottom of all humorous, or caricature sketching. Don't let any one be alarmed, and suppose that it is intended to set you quizzing and caricaturing your friends. Far from it.

Draw the oval, Fig. 34. Divide it by transverse lines into about equal portions. You have now the basis for a face. Let the central line (across) mark the position of the eyes, the line above that the top of the forehead; the one below the bottom of the nose. By Fig. 35 you will



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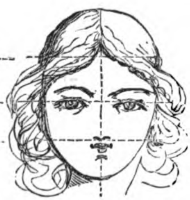

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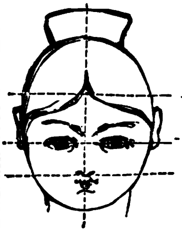

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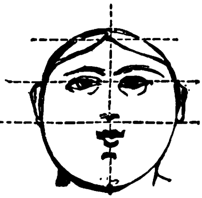


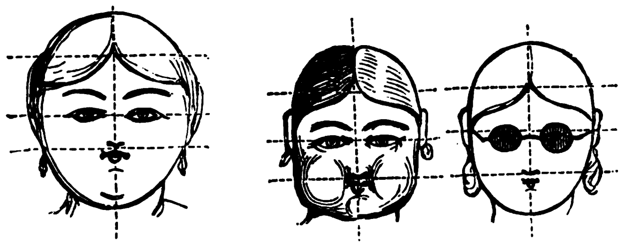
37

see this worked out, and have what is considered a well-proportioned face.

Now oddity of feature or expression is simply the result of a deviation from this regularity; and if, as you will perceive by the other Figs., 36, 37, and 38, these lines are placed higher or lower, or out of their, strictly speaking, *proper places*, you have, as a result, oddity, or comicality, which is founded upon irregularity or incongruity in things.

By and bye we shall carry out this hint more fully, at present merely pointing out, in reference to the Figures 39 and 40, how the end is attained by placing a pair of dark spectacles upon a regularly-featured face, or adding a little flesh to the lower portion of that at Fig. 39.

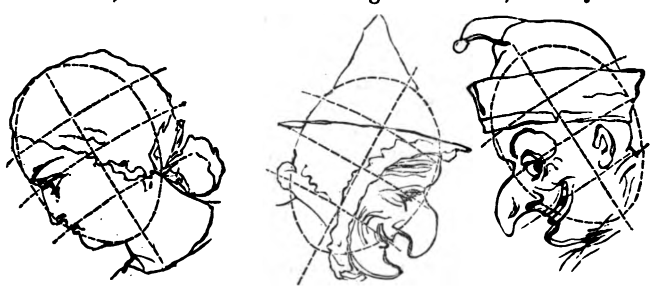
But not to forget the "Art" in the "Sport," let me add, that by



38 39 40

sketching the plain oval, and remarking whereabout the lines of their features would cut it, you may, without difficulty, attempt likenesses of your friends and companions.

Now fill your slates or sketch-books with ovals, and try the effect of which the above are but indications. Your imaginations will furnish an endless variety of subjects. The omission of one eye, or its being covered by a shade, or closed while the other stares; the nose slightly on one side, the mouth a little wider than usual—these are all sources of the humorous, which, however, is far from being heightened by *ugliness*. Indeed, it should be borne in mind, that great distortion or hideousness, so far from contributing to humour, destroys it by



41 42 43

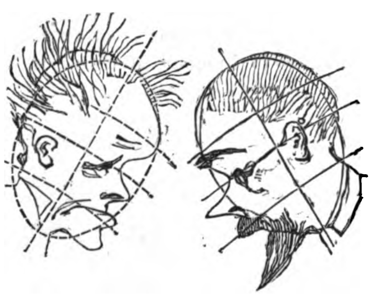
raising painful images in the mind. True humour is closely allied to kindness.

Let us now take the simplest elements of the profile or side face. This is also formed upon the oval, with a slight variation. You will perceive by Fig. 41 that the oval used for profile purposes is divided into four about equal portions, which are appropriated in the same manner. That is to say, the central line across is for the eye, and the other two for the limit of the hair and the bottom of the nose.

But take notice that portions are cut off—*e. g.*, at the back where the neck is inserted; a little has to be added for forehead, chin, and hair; and some modification takes place about the region of the eye.

Suffice it that the oval forms essentially the basis of the structure of a well-proportioned face, such as is shown in the Fig. (41). Draw for yourself, or trace from Fig. 41, a figure for your basis. Next make a number of these tracings upon a clean sheet of drawing-paper, and marking them in very lightly in pencil proceed as directed in the case of the front face in the last lesson; altering the feature lines, lengthening or shortening the chin, nose, and forehead, according to your fancy. This will be a sufficient guide, and illustrations of this are accordingly omitted here.

Let us proceed a step further. The last hint only dealt with the depth relatively of the several parts of the face. Now, as to their prominence. How very easily, by means of a few magic touches, which, by this time, you are magicians enough to impart, may you summon up our ancient acquaintance Mother Hubbard, or the modern hero Punch. (See Figs. 42, 43.)

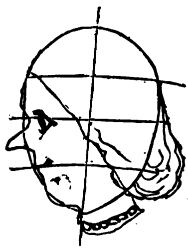


44 45

Observe that the peculiarity of these comic physiognomies consists merely in their deviation from the regularly formed head of Fig. 41. They are constructed upon that figure, which may be seen underneath in dotted lines. The variety of ways in which this exercise may be worked is infinite. Subjoined are a few. In Figs. 44 and 45, beards, moustachios, eyebrows, the hair cut absurdly short, or left redundant, joined to the sinking in of the facial angle, produce the effect of comicality. In Figs. 46, 47, the same end is attained by the simplest means, and with even less exaggeration. And here, we again repeat, that the less deviation there is from the proper proportions the better.

As a pendant to the comical landscape given, we give you the annexed (Fig. 48). Every one will recognise it as a model drawing—such as is to be found upon walls, and occasionally upon the margins of school-books. This the artist intends for a comic drawing.

46



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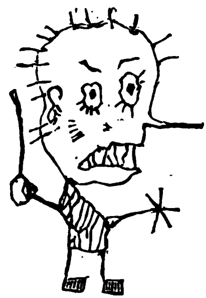


48

In designing the human figure—and we may presume, that, by this time, very many of our readers have been stimulated to become draughtsmen, or, being so to some extent already, to improve their attainments, for their own or their friends' advantage, and that such have really resolved not to stop at butterflies, flowers, or even landscapes, but to make a dash at the grandest object of art, namely, the human form. In designing the figure, there are three principal rules to be observed:—

First, the standard height of the human body may be reckoned as eight times the length of the face. Dividing the entire length by eight, as shown in the annexed diagram (Fig. 49). it will be perceived that the face comprises one of the spaces; the second reaching to the chest; the third, to above the hips; the fourth, cuts the entire length into two equal parts; the fifth extends to the centre of the thigh; the sixth, to the knee-joint; the seventh, to half-way down the leg; and the eighth, to the sole of the foot.

The second rule is, that no part of the body, viewed laterally, is more than twice the thickness of the head. In very young children, however, the rule is, that where the head will go, any part of the body will follow, as the experience of most people has tested.

The third rule concerns the centre of gravity. By reference to the

Fig. (49), a vertical line will be perceived, drawn through the centre of the figure. Whenever the body is at rest upon its legs, standing at ease, as one may say, this imaginary line must always pass through its centre.

We shall see more about this presently, at present confining ourselves to the consideration of the first two rules. These must be considered as only generally true.

They have, however, to be well considered in connection with our present subject; for, as we said with the face, any great deviation from them leads to oddity, and is at the root of caricature drawing.

49

50

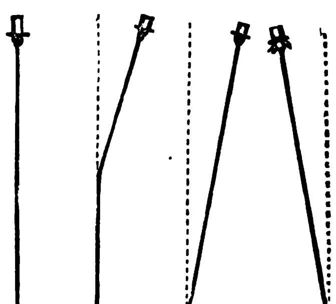
Trace out, or sketch out any size, the figures (Fig. 49 and 50), or any others for yourselves; or taking any well drawn figure in a print, which may not be too costly to use so, draw with a black lead pencil upon the print similar lines to those in the figures, that is to say, divide its length into eight parts or faces, first dropping central lines perpendicular to the ground. You will thus test the accuracy of the rule, and familiarize yourself with the proportions of the figure. Then, for the purposes of comic drawing, you will vary these proportions. A face too long or too short, a body too large or too small for the legs, or legs otherwise disproportionate to the rest of the body will yield the desired results. It will be seen by the Figs. 51, 52, that their oddity has been arrived at simply by this rule, or by the deviation from the strict rule of proportion.

Fig. 53 is given in illustration of the remarks upon the second rule. The form is correct enough, as regards height, and deviates in the matter of lateral proportion.

51 52 53

We have seen how a deviation from the proper proportions of the figure led to the result sought. We now come to consider the third principle—that of the centre of gravity.

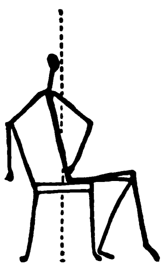
54 55 56 57



Observe in the annexed figures how the first (Fig. 54), being at rest, commends itself to the reason like a mathematical demonstration. The next diagram, showing a partial deviation from the centre of gravity, is in a false position, and we begin either to pity or to laugh—poor diagram! it is very so-so.

The two following figures are other cases of the same sort—we feel instinctively for them—they are very far gone. Try this rule upon your slates or sketching blocks; and after that we will go on to the next subject. In the diagrams (Figs. 58, 59), the same principle is enforced. The first is at rest, because the line passing through the centre of the figure is a vertical line. In the next figure that line being out of the vertieal, the balance is disturbed, and the figure topples; so with the next. This is so plain, that argument is not needed to demonstrate it.

58



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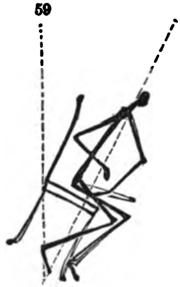

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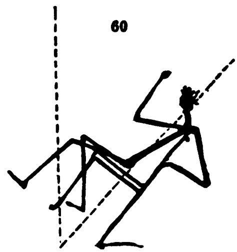
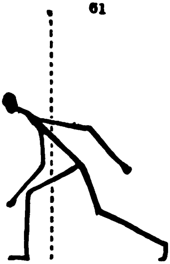


Try this also for yourselves as before. Nor need we confine our experiments to figures comparatively at rest: forms in every variety of action come under the same rule—it is a law of nature. There is a central line drawn through the whole system of the universe, if we could but see it.

The first of the following figures is in full action, but it may go on for ever, as its balance is not in any way disturbed. The second is fast

61



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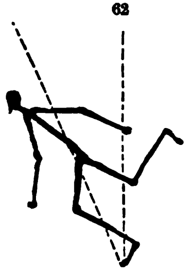

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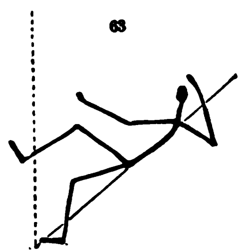
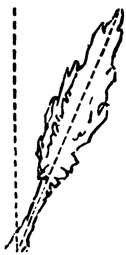


hastening to its fall. The third is much nearer still to that consummation.

It will suggest itself to every reader to apply the rule to other objects than the human figure. Trees in the positions of Figs. 64 and 65 are never seen unless by some violent accident; they may bend, and twist, and meander, but taking the objects as a whole, a central line vertical to the horizon will be detected, as shown in Fig. 66.

64



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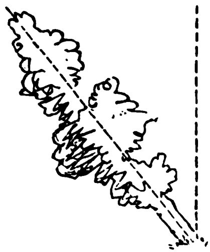
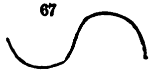


66

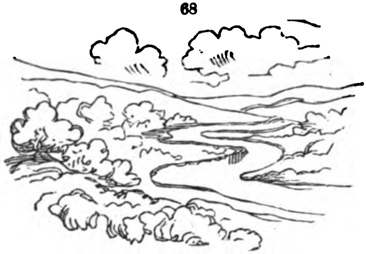
If we turn our attention in any direction upon natural objects,—the clouds, the earth, the sea, flowers, trees, or animal bodies,—we cannot fail to see that *a curved line* is always to be made out in their forms. Indeed, just so far as they are graceful and pleasing objects to the eye, this curved line is distinguishable. On the contrary, square lines offend the eye when met with under such circumstances. It is almost impossible indeed to imagine a square cloud, a square flower, or a square horse. When we see a square-headed man, we are not impressed in his favour. We may have met with representations of natural objects, such as rocks, hill-tops, mountain precipices, and the like, which had a square or nearly square appearance; but such things are almost always presented to our view as phenomena—*i. e.* things violating the regular order or general rule of nature. This curved line, which is the line of beauty, *must* pervade all nature; it is the natural law; and we cannot sufficiently admire the truth that that which is most necessary is also most beautiful.

67



In the annexed Figure (67) you perceive the curved line. In proportion as you are able to make this perfectly, you will succeed in drawing gracefully. We must presume that very many of our readers will have no difficulty in copying the few natural objects suggested below. Practise upon your slate or board the Figure (67) until you can do it easily. Then, for the purposes of "sport," proceed as

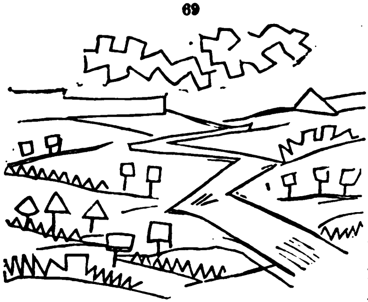
68



follows. You wish to produce a droll "bit" of landscape. Take any simple view, such as is submitted in Fig. 68.

In this you will readily discover, as I said above, the curved graceful lines of beauty—in the clouds, the outline of the distant hills, the foliage, the meandering stream. Let me advise you to practise this lesson somewhat perseveringly; apart from the new source of amusement which it is our object to open up, a beautiful lesson could be impressed upon the mind. Nothing is more calculated to refine the mind, to ennoble the thoughts, than to withdraw oneself sometimes from the artificial world, and to gaze upon the fresh face of nature. And if we are able to do this intelligently,—in other words, if, having learned the alphabet, we are able to peruse as it were the book of nature,—the delight and the advantage is proportionably increased. Now turn to the example shown in Fig. 69. What do we see? The lines of beauty have given place to others less pleasing to the eye, and (except as a source of merriment) less acceptable to the mind. Fig. 69 is a comic landscape; how it has become so must be clearly apparent.

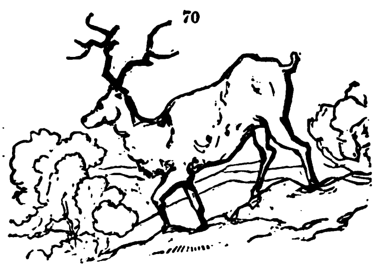
69



In Fig. 70 the same process is carried out, and the result is similar

Do not understand us to mean, that in order to be graceful every thing must be round, or that every thing round is graceful, or that every square object is ungraceful; or, again, that by making any curved line into a square or straight one the end we propose

70



is to be obtained. Doubtless many round things are ungraceful, as many others composed entirely of straight lines at various angles to each other are exceedingly graceful. But what is meant is this: that natural objects, in which, left to themselves, the curved line predominates, are made odd and comic-looking when drawn upon the square.

71

In Fig. 71, not only the lines of the shepherd's form are curved lines, and, therefore, conducive in a degree to its general pleasing character, but the *attitude* is formed upon a curved line. This will be perceived clearer by reference to the next figure (72), in which, without using a single straight line in the parts of the form, the oddity is attained by making the whole attitude stiff and angular.

The student will find no difficulty in multiplying examples for himself; those given will suffice as hints. We must now proceed to show how comic designs may be made and applied to the slides of magic-lanterns. The proper course of procedure is as follows:—

72

Procure a piece of clear common window-glass, without specks or scratches; let this be made perfectly clean. Prepare your design, which should be made the exact size you intend it to be painted upon the glass; colour it; and when quite dry place it beneath your slide of glass. to which it might be fastened at the corners, by means of a little gum or varnish. Now commence to paint upon the glass an exact facsimile of the design, which, of course, you see clearly enough through the glass Common camel's-hair brushes will do; those made of sable are, however, much better; but the first will suffice for ordinary purposes.

The colours necessary are what are called silica colours, and are procurable of most artist-colour makers.

It will be necessary to let your first colours dry before putting on your shades; and it is desirable not to work in too hot a room, as the nature of the varnish with which you work is to dry very rapidly.

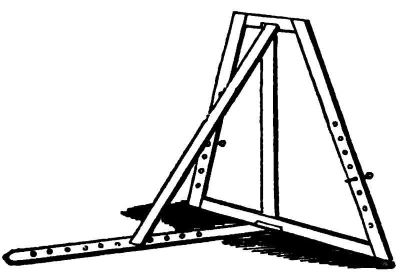
Bear in mind too, that upon glass you cannot wash in a tint. Broad surfaces, such as skies, must be stippled in, as in painting upon ivory.

OIL PAINTING.

We begin by supposing that you now can *draw*, and, that you can, either from a fair knowledge of perspective, or a naturally correct eye, copy any object in the room, as the books on the table, the jar of flowers, or the coal-scuttle; for, though a person *may*, without being able to draw from nature, produce a highly finished copy of a picture, there would be more labour than pleasure in the task; while an *original*, if only a wheel-barrow and besom grouped with taste, would give far more delight in the doing, and you would acquire an artistic freedom of hand by such studies.

In the next place, we suppose that you can see colours according to nature, for many persons see them too bright, or quite the reverse of what they are.

We will now proceed to describe the materials actually required in this art. If our pupil can command a room to himself as a studio, if ever so small, so much the better. This, however, is not at all needful —a moderate sized table will be all the space he requires to engross.



An easel, palette, palette-knife, brushes, colours, a little oil and varnish, and some prepared mill-board are all that is necessary, and they are not very expensive.

As a large easel standing on the ground is only fit for a studio, we give a sketch of a "table-easel," which is both simple and portable, and may be made by any carpenter; it will fold up quite flat, and pack at the bottom of a box. It is 18 inches high, 15 wide at the base, 7 wide at the top, 20 long for the leg, and 22 for the stand; this is provided, with holes, and regulates the inclination of the easel. A loose grooved bar of wood, about 18 inches long, rests on 2 pegs, which are placed in the holes in front of the easel; this supports the picture.

The palette should be made of mahogany, of an oblong shape, and light in weight.

The palette-knife to mix the colours should be pliant and well-tempered.

The brushes we recommend are, two flat hog's hair brushes in tin, Nos. 2 and 7; two flat sable brushes in tin, Nos. 4 and 8; three round sable brushes, Nos. 1, 4, and 6.

These seven tools will be amply sufficient to begin with, but some camel-hair ones, in quills, the same as those used in water-colour drawing may be added; they are very cheap. A brush called a "badger softener" is of use in painting skies, but they are expensive, and may be dispensed with at first.

The colours are enclosed in air-tight metal tubes, and the capsule being unscrewed, you squeeze the colour up from the bottom of the tubes. We give a list of the most useful colours, and from which almost any picture may be painted. Of these, the first six are opaque, and the remainder transparent; we wish the pupil to bear this in mind.

1. Flake white; 2. Naples yellow; 3. Light red; 4. Indian red; 5. Vermilion; 6. Terra verte; 7. Burnt umber; 8. Raw sienna; 9. Burnt sienna; 10. Antwerp blue; 11. Ivory black.

There are also some extra colours, which are of higher price, and used in finishing; these are, French ultramarine, and madder lake. These are very beautiful, and are chiefly used in sky tints, and in delicate flesh tints.

The price of the tubes of paint is sixpence each, that of the extra colours one and sixpence each; but they last for a long time.

Of oils and varnish, you require some raw linseed oil, some light drying oil, a bottle of mastic varnish, a little spirits of turpentine, and a little olive or eating oil.

The prepared millboards for painting on are of all sizes, 6 inches by 8, to 24 by 20, and the prices are from sixpence to three shillings each. Academy boards are similar, but thinner and cheaper, and may easily be cut to what size you like. Oil sketching-paper (which is only drawing-paper covered with two or three coats of paint) is cheaper still, and for first trials is very useful. It must be fastened with drawing-pins to a board when used, or if a very small sketch, it may merely rest on a board or a book. With the addition of a small tin "dipper," or a galli-pot, and a few clean rags, our materials are complete.

The palette must be prepared for use by rubbing into it as much raw linseed oil as it will absorb; repeat this for two or three days, and then rub it dry with a rag. It will now have a fine polished surface, and the colour will not sink into it.

Your subject must be sketched on the millboard, before you begin your painting operations—a fine light pencil is best for small pictures, but chalk or charcoal is generally used for large subjects. A wet rag is better than India-rubber for correcting mistakes. Let your lines be as few and light as possible, and make the drawing very carefully, that you may not be troubled with alterations when you begin to paint.

You now mix up in the *dipper* (which is a little tin cup, made to fix on the palette, though a pomade-pot with a cover does quite as well) the "*Vehicle,*" which is a preparation of oil and varnish, used to temper the colours and make them work pleasantly. There are many kinds of "vehicles," and artists differ greatly in their choice. That known as "*Meglip*" is what we advise, and is made by mixing equal parts of the mastic varnish, and light drying oil; stir it for a few moments, and it will become a kind of jelly. Make no more than you require for your day's painting; half a tea-spoonful of each is enough.

You now "*set your palette,*" as it is termed; that is, you squeeze out of the tubes portions of colour about the size of a nut, and lay them along the upper edge of the palette, beginning from the thumb-side in the following order—*white*, *Naples yellow*, *raw sienna*, *burnt sienna*, *light red*, *Indian red*, *vermilion*, *terra verte*, *umber*, *blue*, and *black*. You have thus ample space for mixing, with the knife, the various tints on the lower part of the palette. The lighter tints are generally placed on the right-hand side of the palette. White or black is usually combined with all colours, as they are required lighter or darker. To make any tint, take on the point of the knife a small portion of the meglip, and the colours you want, mix them on the palette, scrape them up, and lay in gradations. The following is a set of flesh-tints for a head or figure:—

LIGHTS.—White and a *little* Naples yellow; white, Naples yellow, and vermilion; white, vermilion, or light red.

MIDDLE TINTS.—White, black, and vermilion; white, black, and Indian red; white, terra verte, and a little vermilion.

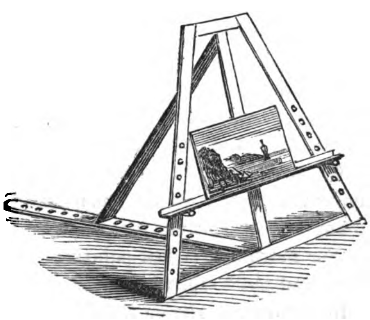
SHADOW TINT.—Black, Indian red, and a little umber.

The tint of pearly blue we see under the eye is produced by white, vermilion, and ultramarine. For the greenish shade on the forehead and complexions of sallow persons, the terra verte tint is beautiful.

PORTABLE TABLE-EASEL.

Having the palette now set, you are ready to begin to paint. Place your picture at a convenient height, so that you may not stoop to it; the left hand holds the palette, and "*rest*, or *mahl stick*" on which you support the right hand, as shown in the engraving. The hands should be at some distance from the body, and the artist should sit rather erect, so there is no danger of injuring the chest. It is better to copy at first from a painting, matching the tints as nearly as possible, by holding them close to the original, on the knife. It is, however, very good practise to copy from engravings, where the artist must use his own taste in the colouring.

We will imagine a sketch of a "little shrimper," and will now direct our pupil how to paint it throughout; it is an easy study, and will make a pleasing picture.



The sky round the head, cool gray cloud, composed of black, white, and vermilion; above the cloud a little blue sky of ultramarine and white, and a few streaks of white, Naples yellow, and vermilion at the horizon. The distant hill—shades of white, black, and raw sienna; the ground, or shore—raw umber, white, or raw sienna, white, and black; the lightest part of the sea—black, white, and Naples yellow, melting off to black, and white, and a *little* blue; the pool of water in the foreground—

black, white, burnt sienna, and a little gray in the lights (as the reflection of the sky); the basket and net—black, umber, or sienna; the face, hands, and legs may be painted with the flesh tints, and a little Indian red and vermilion for the lips, and black and burnt sienna for the eyes; the cap—for the *darks*, Indian red, black; *middle tint*—vermilion, Indian red; *high light*—vermilion and white. For the fold of white round the neck—white, subdued with umber; for the jacket—raw sienna, burnt sienna, and black in the shadow, and raw sienna and white in the light; for the trowsers—tints of blue and black and blue and white; for the boots—black and a little Indian red, with white touches of light.

Paint in the sky first with a flat sable brush, not overloaded with colour, and rub it in well, so as to have no thick patches of colour on the board—soften with a hog's-hair tool. The distance must also be painted with little body of paint. With a small brush lay in the face, the eye, and dark parts first, with more colour in your brush than for the sky; then work downwards at the dress, &c., finishing as correctly as you can, laying on the lights with a flat sable, and with thicker colour on the shadows. The net must be painted with thin colour *over* the sky. The finishes the first painting, or "dead colouring," as it is called. When quite dry (which in summer will be in a day or two, but in damp weather longer,) wash it with cold water, and dry it with a soft cloth; this is to prevent the colours from running and working as if they were greasy when you begin to paint again. Rub over the parts you intend to paint with a brush wet with a little linseed or oil, or meglip, so as to leave the *least possible* quantity on the painting. This makes the colours combine with the first painting, and also enables you to wipe them entirely off, if you cannot succeed to your mind, while the previous work remains as it was.

Go over the painting with the same tints as in the dead colouring, improving, and softening, marking the high lights rather lighter, laying them on with spirited touches, and with rather stiff colour.

For the third, or last painting, when perfectly dry, wash and oil as before, and touch up, where it is needed, with the delicate flesh tints, add a little madder lake on the cheeks.

The *glazing* is put on at this stage of the picture—that is, laying some transparent colour, mixed only with meglip, over any part, to enrich and give it depth, thus, some burnt sienna, glazed over the red cap, will have a very good effect. It must be put on sparingly, so as to see the former paintings through it, and even taken off entirely with a rag or the finger, in some places, as on the highest light. In the same manner may the jacket be glazed with burnt sienna, the trowsers with blue, and a little madder lake in the shadows, to enrich them.

We will now give a few general hints on working up a painting:—

Lay your colours on steadily and boldly, with as few strokes of the brush as you can help. Keep your tints pure and distinct, each in the place you mean it to be. Do not by going over and over them with the brush, muddle and mix the tints, for some tints destroy each other, and the transparency and beauty of the painting will be lost. In softening or uniting two tints, it is best either to use an intermediate shade, or else with a clean brush and no colour to melt them together. Much depends on the first painting. It should be lighter in colour than the picture is intended to be, as all colours sink, more or less, into the ground as they dry, and it can easily be glazed and toned down to the proper colour. The shadows should be put on thin in colour, the lights with a greater body of paint, with a sharp and firm touch. The brightest lights may be painted quite white, and glazed to the intended hue; but, though beautiful effects are produced by glazing, it is dangerous for the student to be too free in the use of it. Be as careful as you can in the earlier paintings, for it is impossible to glaze a bad picture into a good one.

"*Scumbling*" is the reverse of glazing, and is done by going over the painting, when quite dry, with opaque tints of a lighter hue, generally with a mixture of white. It is of use in cooling down colours that are too bright, and in making objects appear more distant; smoke, mists, and the haziness of the far-off hills, are thus produced. It should be laid on very thinly with a hog's-hair tool. Scumbling, however, must not go over shadows, as that would spoil their depth.

PORTRAIT PAINTING.—In painting a head, begin with the eyes and nose; then the forehead, mouth, cheeks, and hair; then go to the background, commencing at the top of the picture, and working down to the head. Backgrounds are very various, but there is generally a little lightish tint near the face, which melts off into a deep shadow to the upper part of the picture. In black hair, or draperies, mix a little Indian red, to give a warmth and harmony. A brilliant effect is produced by some painters, who lay the first colouring of a head in gray tints only, composed of black, white and Indian red, of different shades, using pure white for the high lights, and, when dry, glaze it all over with madder lake, and raw sienna; then put on the carnation tints, and point up the shadows with burnt sienna and black. This would answer best for a large head, and is only one of the vagaries in which artists indulge. Let the beginner get the picture as like the copy as possible in the first painting, though rather lighter in tone.

During the progress of the work, frequently retire and look at it from a distance, to judge of the effect; to examine it also in a looking-glass is a good plan to detect any faults in the drawing. If you are copying from anything in nature, either landscape or figure, look at it occasionally with the eyes half closed, or through a tube or roll of paper; the lights and shadows will by this means appear more distinct and defined and the object more raised, and be more easily copied.

As LANDSCAPE PAINTING is one of the most favourite branches of the art, so it is one of the easiest; for, while keeping the general outline of a view, we can allow ourselves much latitude in details; we may make our trees more full in leaf, our rocks more moss-grown, our rivers more clear, and either bathe our scene in the golden light of sunset, or make it solemn with "dark driving clouds," without in any way affecting the truthfulness of the scene.

The hints which we will give shall apply to any style of landscape.

The *sky* is always put in first, beginning with the blue of the sky, and working downwards with the various tints, be they golden or gray, according to the aspect you have chosen. In a clear, unclouded sky, the blue is deepest above our heads, and melts off to the horizon till it becomes a tender gray. *Ultramarine* and *white* is the purest sky tint, and a little *black* and *vermilion* combined with it gives the most beautiful grays. Clouds are painted over the clear sky with deeper shades of gray, or with a little umber mixed with it; their bright edges are put on after the work is dry, and may be pure white, or some flesh-coloured tint, according to the reflection of the sun. Lay the colour on sparingly with one of the larger brushes, in touches or pats, from left to right, beginning from the left-hand corner of the picture. The distances are put in with the gray sky tints, but a little darker in tone. The sky and distance should be softened with a large brush, and allowed to dry before proceeding to the other parts.

Trees, if thin of leaf, and showing much light through them, should be painted over the sky, otherwise they may be laid in at once, in masses of light and shade, and the leaves made over them when dry, with little touches of the brush, and rather thicker colour. There are many different "touches" for foliage, and it requires a little practice to get the habit of doing it well; some, with a fine brush with plenty of colour in it, make a kind of little loop, as if they were going to write the letters O or C; this leaves an oval, full touch. Sometimes a brush is crushed flat upon the colour, and stabbed on the painting, this leaves a star-like touch. Or an old hog or flat sable brush, with the hairs worn, and of different lengths, is used for a jagged foliage. These various touches may be pointed up and corrected by a fine brush. The receding parts of the foliage and the leaves that come against the sky, are painted with thin, transparent colour, with a small tool; the light touches with opaque tints. Foliage should not be made of too glaring a green. A good set of tints is made of *blue*, *raw sienna*, and *white*, *blue* and *burnt sienna;* and for light touches, *raw sienna* and *white*, or *Naples yellow* alone; for the dark shadows no blue is needed; shades of *black* and *raw* and *burnt sienna* give a warm olive tone. The lights may be glazed with *sienna* and a little *blue* to enrich them. You may produce the rough bark of near trees by painting the trunks rather dark, and putting over rugged, uneven touches of lightish gray, with a very full brush, and glazing it when dry with black and burnt sienna. For trees which are at some distance, and whose foliage appears of a grayish yellow cast, use *black*, *Naples yellow*, and *white;* for *very* distant trees, add the *French blue* and a little light red, to give the atmospheric tint.

The *foreground* must be painted with stronger colours, larger brushes, and bolder touches. For stalks of grass and weeds, a fine-pointed brush is used, and jerked upwards, which gives a spirited touch. For flat rocks or stones the lights are sometimes put on with the palette knife, the colour being taken on the knife, and laid upon the picture, in the manner (to use a homely simile) of spreading bread and butter; but as a nervous hand would most likely fail in this, the brush is the safest for a beginner. The foreground shadows should be glazed with rich tones of browns and olives. When the painting is finished to your mind, by touching upon it here and there (though you must be careful not to do *too* much, and spoil the spirit of it), you may scumble the distances; and the sky, if too blue, with white alone, or a gray tint; this gives a misty softness to the whole, and brings it to a conclusion.

We have thus given a few general rules for landscape painting, which is all we can do, nature's tints being innumerable. Try on your palette different combinations of colour, and you may find out some beautiful tints yourself; and if you see any peculiar light or shade in your walks, try and discover the colours it is composed of—indeed, a painter should be always looking out for *effects*, always trying to learn something fresh from Nature herself, and every day the study will become more interesting.

We must not forget to give some directions for *cleaning up*, on which all your comfort in painting depends, if not much of the beauty of the picture. *Never* leave your tools uncleaned till next day; the paint will dry on the palette, and the oil in the brushes, and soon quite spoil them. Take up, on the knife, all the bits of pure colour you have to spare, and lay them on a plate; pour over them as much cold water as will cover them, and they will keep several days soft and workable. Scrape off the palette all the waste colour and oil; wipe it with a rag; pour on it some linseed oil, in which clean all the colour out of the brushes, wiping them, now and then, with a rag; dip them in clean oil, which is to remain in them. Wipe the dirty oil off the palette; put a little fresh on it, and rub it clean and dry. Be careful to keep it, and also the brushes, from dust. If some days are likely to elapse between your paintings, clean the brushes with spirits of turpentine, and dip them into *olive oil*, they may then be left for a fortnight without getting stiff, or "tacky"—the *turpentine* must be all wiped from them, or it will eat away the hair. Wash the hog tools in soap and water—warm is best—dry them by rubbing lightly and quickly over a cloth. After using oils or varnish, wipe the mouth of the bottles, to prevent the corks sticking fast; wipe the tubes, too, after using, that they may screw properly. All this may be speedily done with plenty of rags (old stockings make the best) and a newspaper underneath, with very slight soiling of the fingers.

Having now carried you through the practical part, we will speak of the subjects most suitable for the pencil. The various branches of art are divided as follows:—

The historical, or grand style, which includes historical, classical, and Scriptural subjects: this is the highest branch, and few can hope to arrive at excellence in it; as it not only requires a thorough knowledge of anatomy, but a fertile and well-stored mind.

Portrait painting is a delightful field for the pencil, and affords more pleasure than almost any other branch. Moreover, it is not much mor difficult to copy a head from nature than from another painting. Persuade some friend who is good natured enough to submit to be caricatured, or made hideous for the first few trials, to sit to you, and you will soon find it become easy. An old person's face, with strongly-marked features, is the best study—children and young people are more troublesome as to expression.

Landscape, which includes *Marine* subjects, is a most popular style, and one very suitable to our young students.

Flower Painting in oil we do not admire, for though some of the Dutch masters have bequeathed us many most highly finished pieces, the water colours of the present day give a far more brilliant effect.

Genre Painting is a term taken from the French, and is defined as "pictures of life and manners." This is, we think, the *most* delightful of all styles, both to the artist and the beholder. "Pure nature, true humanity, national character, as revealed by domestic manners, all the passing events of life, &c., form the circle of true Genre Painting." A child caressing her kitten, a market woman offering her fruit, some episode of life, gay or sad, are fitting subjects for this style. Fruit, or game pieces, and still life, may also be classed under this head.

Thus we have explained the chief branches of art.

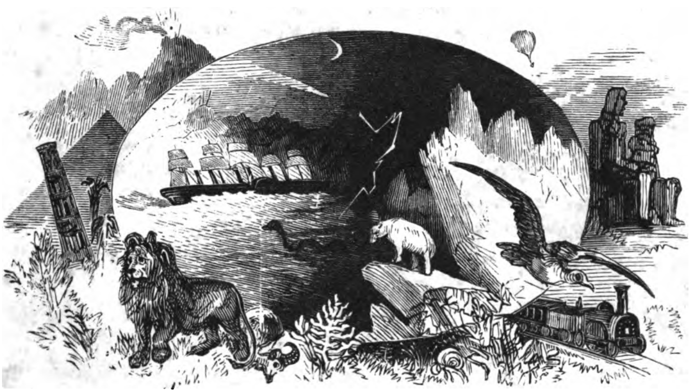
Take our advice, young student, keep your eyes open; there are pictures all round us, if we could only see them. The most trifling incidents chosen and treated with taste, makes a picture. Do not say, then, you can find nothing to paint; if you live in the country every village has its well, and every well has its group of gossiping crones, or sunburnt damsels; if in a town, the street, however new and genteel, will have it patient organ-boy and tame mice, or anxious maiden waiting for the postman's rap, and many other little scenes which have a story to tell. Accustom yourself to sketch in pencil anything of this sort which strikes you, from life, if possible, or recollection. Copy also in your book any picturesque "*bits*" you meet with in your walks, as the stump of an old tree, a fragment of rock, &c., and keep them as a little store to draw upon when you compose pictures.

As a general rule in composing pictures, the principal object should be placed *near* the centre, and receive the brightest light and colour. Let your colours be well *balanced;* for instance, if you painted an in-door scene, where browns, reds, and yellows prevailed, and in one corner put a bright blue object, the eye would be so drawn towards that object, that we should lose sight of the other parts of the picture; but paint that bit in a more subdued blue, and repeat the colour, by a lighter blue, or lilac, in the draperies, &c., nearer the middle of the picture, and harmony is restored, while the eye rests without great effort on the main subject of the picture. Strive to make your colouring rich and glowing, not glaring. It is useful to make small studies from still life, by grouping together, and colouring exactly, such things as a vase, books, &c., or a rich drapery thrown over an antique chair, or tubs, brooms, and kitchen utensils.

Those who attend the exhibitions of art may learn much, not only by observing the general effect of a picture, but by looking closely into it, to find out how that effect is produced, and the peculiar handling of the master.

We now bring our hints to a conclusion, hoping that some who have read them may be inclined to put them in practice. We do not promise them that they will become Titians or Claudes in a day, but we do say that they may acquire a delightful and interesting employment, and be capable of understanding more advanced instructions.

THE ILLUSTRATED BOYS' OWN TREASURY OF



WONDERFUL THINGS AND WILD ANIMALS.

GREAT WALL OF CHINA.

The Great Wall, called *Wan-li-Chang* (*i. e.* Myriad-Mile Wall) by the Chinese, was built by Tsin Chihwangti about B. C. 220, in order to

protect his dominions from the incursions of the northern tribes. It is sufficient evidence of the solidity of its original construction, that it has remained so well preserved in a region of frosts and moisture. The ships of the first English Expedition visited the point on the coast of Liautung, at Shanhai wei, latitude 40° 4′ N., longitude 120° 2′ E., where it commences its course, and which is described as a place of considerable trade: the gate here is called *Shanhai kwan*, or Hill-sea barrier. Lord Jocelyn describes it, when observed from the ships, as "scaling the precipices and topping the craggy hills of the country, which have, along this coast, a most desolate appearance." It runs along the shore for several miles, and terminates on the beach near a long reef. Its course from this point is west, a little northerly, along the old frontiers of the province of Chihli, and then in Shensi, till it strikes the Yellow River, in latitude 39½° N., and longitude 111½° E. This is the best built part, and contains the most important gates, where garrisons and trading marts are established.

Within the province of Chihli there are two walls, inclosing a good part of the basin of the Hang-ho, west of Peking; the inner one was built by one of the emperors of the Ming dynasty. From the point where it strikes the Yellow River it forms the northern boundary of Shensi, till it touches that stream again, in latitude 37° N., inclosing the country of the Ortous Mongols. Its direction from this is north-west along the northern frontier of Kansuh to its termination near Kiayukwan, through which the great road passes leading across Central Asia, in about longitude 99° E., and latitude 40° N.

From near the eastern extremity of the Wall in the province of Chihli, extending in a north-easterly direction, is a wooden stockade, or palisade, which forms the boundary between Liautung and Kirin, and has been often taken, from its representation on maps, as a continuation of the Great Wall. It was erected by the Manchus, and garrisons are placed at the twelve gates through which the roads pass, leading from Shingking into Mongolia.

The entire length of the Great Wall, including all the doublings, is estimated by McCulloch at 1,250 miles. The construction of this gigantic work is somewhat adapted to the nature of the country it traverses. In the western part of its course it is less substantially built than in the eastern, being in some places merely a mud or gravel wall, and in others earth cased with brick. The eastern part is generally composed of a mound of earth and pebbles, faced with masonry, supported on a coping of stone, the whole being about 25 feet thick at the base, and 15 feet at the top, and varying from 15 to 30 feet high; the top is terraced with tiles, and defended by a slight parapet, the thinness of which has been taken as proof that cannon were unknown at the time it was erected.

There are brick towers upon it at different intervals, some of them more than 40 feet high, but the usual height is a little under that elevation. They are not built upon the Wall, but are independent structures, usually about 40 feet square at the base, diminishing to 30 at the top; at particular spots the towers are of two stories when they are nearly 50 feet in height.

This remarkable structure did, no doubt, in some degree, serve as a barrier, against the incursions of the nomadic tribes near it, for many ages after its erection, though it is plain from the facts of history that it availed but little against the attacks of their enterprising chieftains. At present it is simply a geographical boundary, and, except at the passes, nothing is done to keep it in repair; most of the garrisons are located at these points. Beyond the Yellow River, to its western extremity, the Great Wall, according to Gerbillon, is chiefly a mound of earth or gravel, about 15 feet in height, with only occasional towers of brick, or gateways made of stone. A structure of this sort, in such a climate, must of course soon be overgrown with trees of greater or less size; but none of those who mention having crossed it speak of this circumstance, from which it might be inferred that care was taken to prevent the growth of plants upon it.

CORAL REEFS.

Coral reefs are produced by innumerable small zoophytes, properly called *Coral-insects*. The Coral insect consists of a little oblong bag of jelly closed at one end, but having the other extremity open, and surrounded by tentacles or feelers, usually six or eight in number, set like the rays of a star. Multitudes of these minute animals unite to form a common stony skeleton called *Coral*, or *Madrepore*, in the minute openings of which they live, protruding their mouths and tentacles when under water; but suddenly drawing them into their holes when danger approaches. These animals cannot exist at a greater depth in the sea than about ten fathoms, and as the Coral Islands often rise with great steepness from a sea more than three hundred fathoms deep, it would seem that a great alteration must have taken place in the depth of the ocean since the time when these little architects commenced their labours. Throughout the whole range of the Polynesian and Australasian islands, there is scarcely a league of sea unoccupied by a coral reef, or a coral island; the former springing up to the surface of the water, perpendicularly from the fathomless bottom, "deeper than did ever plummet sound;" and the latter in various stages, from the low and naked rock, with the water rippling over it, to an uninterrupted forest of tall trees. "I have seen," says Dalrymple, in his 'Inquiry into the formation of Islands,' "the coral banks in all their

stages; some in deep water; others with a few rocks appearing above the surface; some just formed into islands, without the least appearance of vegetation; others with a few weeds on the highest part; and lastly, such as are covered with large timber, with a bottomless sea, at pistol-shot distance." In fact, as soon as the edge of the reef is high enough to lay hold of the floating sea-wreck, or for a bird to perch upon, the island may be said to commence. The dung of birds, feathers, wreck of all kinds, cocoa-nuts floating with the young plant out of the shell, are the first rudiments of the new island. With islands thus formed and others in the several stages of their progressive creation, Torres' Strait is nearly choked up; and Captain Flinders mentions one island in it covered with the *Casuarina*, and a variety of other trees and shrubs, which give food to paroquets, pigeons, and other birds, to whose ancestors, it is probable, the island was originally indebted for this vegetation. The time will come—it may be ten thousand, or ten millions of years, but come it must—when New Holland, and New Guinea, and all the little groups of islets and reefs, to the north and north-west of them, will either be united in one great continent, or be separated only with deep channels, in which the strength and velocity of the tide may obstruct the silent and unobserved agency of these insignificant, but efficacious labourers.

A barrier reef of coral runs along the whole of the eastern coast of New Holland; "among which," says Captain Flinders, "we sought fourteen days, and sailed more than five hundred miles, before a passage could be found through them out to sea." Captain Flinders paid some attention to the structure of these reefs, on one of which he suffered shipwreck. Having landed on one of these new creations, he says, "We had wheat-sheaves, mushrooms, stags' horns, cabbage-leaves, and a variety of other forms, growing under water, with vivid tints of every shade betwixt green, purple, brown and white."—"It seems to me," he adds, "that when the animalcules, which form the coral at the bottom of the ocean, cease to live, their structures adhere to each other, by virtue either of the glutinous remains within, or of some property in salt water; and the insterstices being gradually filled up with sand and broken pieces of coral washed by the sea, which also adhere, a mass of rock is at length formed. Future races of these animalcules erect their habitations upon the rising bank, and die in their turn, to increase, but principally to elevate, this monument of their wonderful labours." He says, that they not only work perpendicularly, but that this barrier wall is the highest part, and generally exposed to the open sea, and that the infant colonies find shelter within it. A bank is thus gradually formed, which is not long in being visited by sea-birds; salt plants take root upon it, and a soil begins to be formed; a cocoa-nut, or the drupe of a pandanus, is thrown on shore; land birds visit it, and deposit the seeds of shrubs and trees; every high tide and gale of wind add something to the bank; the form of an island is gradually assumed; and last of all, comes man to take possession.

"Every one," says Mr. Darwin, "must be struck with astonishment when he first beholds one of these vast rings of coral rock, often many leagues in diameter, here and there surmounted by a low verdant island with dazzling white shores, bathed on the outside by the foaming breakers of the ocean, and on the inside surrounding a calm expanse of water, which, from reflection, is of a bright but pale green colour. The naturalist will feel this astonishment more deeply after having examined the soft and almost gelatinous bodies of these apparently insignificant creatures; and when he knows that the solid reef increases only on the outer edge, which, day and night, is lashed by the breakers of an ocean never at rest."

Coral being beautiful in form and colour, is sought after for purposes of ornament; and its fishery or gathering gives employment to many persons in the Red Sea, the Persian Gulf, the Mediterranean, and other places. In the Straits of Messina, the rocks which yield coral are from about 350 to 650 feet below the surface of the water. The coral here grows to about the height or length of twelve inches, and requires eight or ten years to come to perfection. In the general mode of fishing for coral, the instrument used consists of two heavy beams of wood, secured together at right angles, and loaded with stones to sink them. Hemp and netting are attached to the under side of the beams, to the middle of which is secured one end of a strong rope, by which the apparatus is let down from a boat and guided to the spots where the coral is most abundant. The branching form of the coral causes it to become entangled in the hemp and network, by which means it is broken off from the rock, and drawn up with the apparatus to the surface of the water.

DROPPING-WELLS.

Should any of our boys ever journey through Yorkshire, let them endeavour to stop opposite the ruins of Knaresborough Castle; because, on the south-west bank of the river Nidd, they will observe the petrifying spring of Knaresborough,—the celebrated dropping-well—where the peasants and the needy crowd to make their humble fortunes by afterwards retailing small sprigs of trees, such as the elder or ash, or pieces of the elegant geranium, the wild angelica, or the lovely violet, turned into "obdurate stone."

It is well known that, as water passes over land in its course to a given place, certain petrifying principles are absorbed from the soil; and although the transparent fluid flows onward without betraying the minerals with which it is impregnated, yet its properties may be completely changed since its departure from the original source.

Every spring does not possess the petrifying properties of that of Knaresborough; but there are, doubtless, many dropping-wells distributed over the earth's crust; and some of these are well known to possess the property of petrifying various objects submitted to the action of their waters. For example: we have seen bird's nests, with the eggs, and delicate sprigs of moss surrounding them, and even the fibres of wool turned into stone, aye, and delicate flowers. Whence is this extraordinary power? From the soil over which the waters flow! The limpid streams absorb the siliceous particles, and deposit them in the intimate structure of the materials submitted to the action of the waters; and thus we find the materials of which the earth's crust is composed always undergoing a change.

Captain Skinner says, that at Sansadhara, in India, which is known as the dripping-rock, there is a singular phenomenon situated at the head of a dell, through which a rapid stream runs, between two lines of hills towards the valley of the Dhoon. It is an overhanging rock, about fifty feet high, and the water pours from above, in innumerable little streams, like a perpetual shower of rain! The never-abating action of the water has worn the rock into many fantastic shapes; and, crusting round the moss and fibres of the roots of trees, has given to it almost the appearance of a spar cavern. In several places the water has worn little reservoirs for itself, which are always full.

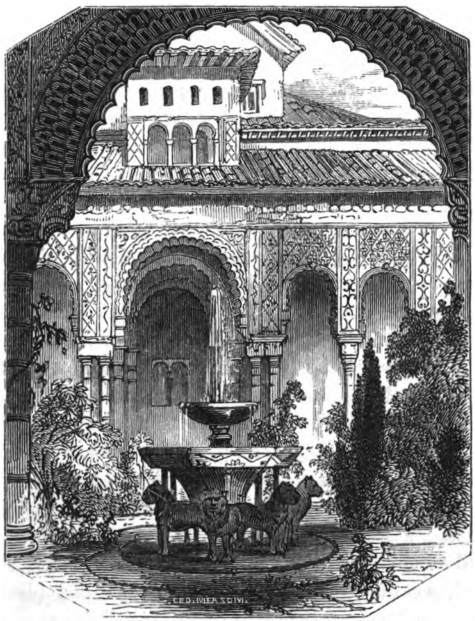
Many springs of this character are to be met with in the neighbourhood of volcanoes: and even in the remote parts of our own land, uninfluenced by the convulsions of nature. They still drop the crystal and petrifying fluid through the projecting cliffs crowned with moss, grass, and the twining branches of parasitic plants. The peasant wends his way along the uncertain path, as unmindful of Nature's fearful changes around him as the team that precedes him; and even the setting sun imbuing the floating clouds with all the gorgeous hues of his ephemeral existence, is equally disregarded. Onward goes the peasant unheeding he passes the dropping-well, which trickles through the clefts amidst the massive rocks, and falling through the intermediate space, trickles its petrifactive power on the surface below. Twenty gallons are poured forth every minute from the top of the Knaresborough cliff, and

DROPPING-WELL OF KNARESBOROUGH.

the beauty of the scene can only be appreciated by those who have stood upon the margin of those "stony waters" and beheld the crystal fluid descend from above with metallic fall. We deem the dropping wells to be one of the most picturesque sights in England.

THE ALHAMBRA.

The Alhambra is an ancient castle and palace of the Mohammedan kings of Granada. It was built by Mohammed II., about the year 675 of the Hegira, or 1273 of our era. He gave it the name of *Medinet Alhambra*, or the Red City; according to some writers on account of being made of a kind of red clay, but according to others, from the



name of Mohammed Alhamar. The Alhambra walls are built of a kind of cement of red clay and large pebbles, which being exposed to the air acquires the hardness of stone.

The exterior of the castle presents nothing very striking. The Alhambra is situated on a hill, which runs out to the east of the town of Granada. It is surrounded by a strong wall, flanked by square towers, and inclosing an area of 2,500 feet in length and 650 in breadth. It is said that 40,000 men could be conveniently lodged in it. The walls follow all the windings of the mountain, and are constructed according to the best rules of fortification in the middle ages; before the invention of gunpowder it must have been impregnable. The river Darro flows by the base of the hill, on the east, north, and west. In this limited space the kings of Granada had united everything calculated to afford security in time of war, and comfort and pleasure in time of peace.

The easiest ascent is by the street of the *Gomeles*, so called from a distinguished Moorish family of that name. In coming out of the *Puerta de las Granadas* or "pomegranate gate," the road is divided into three, the middle one for carriages, and the other two, which are very steep, for foot passengers. The middle road ascends, between the hills of Alhambra and *Torres Bermejas*, through a very thick wood of lofty elms, the branches of which are so interlaced that the rays of the sun never penetrate their thick foliage. Innumerable clear rivulets glide through the forest irrigating the ground, which is covered with verdure; or fall from rock to rock, forming a number of beautiful cascades. Near the summit of the hill is the fountain of Charles V. on a sort of natural terrace, from which there is a bird's-eye view of all the ascent, which amply repays for the fatigue. After passing this fountain the traveller comes in sight of the Alhambra gate, called *Judiciaria* or of Judgment, because justice was administered there after the custom of the East. It is a square tower, the horseshoe arch of which rises to half the height of the tower, and is a perfect model of this kind of arch, so characteristic of Arabian architecture. Upon the stone in this tower is the following inscription in Arabic which is thus rendered by James Murphy:—"This gate, named Babu-sh-shariat, may God prosper through it the law of Islam, even as He has established it a monument of glory, was built at the command of our Lord, the commander of the Muslins, the just sultan Abu-l-Hajjaj, son of our Lord, the warlike sanctified (deceased) sultan Abu-l-Walid Ibn Nasr, whose pious deeds for religion may the Almighty recompense, and whose valorous performance in the cause of the faith may He graciously accept. And it was completed in the month of the glorious birth of Muhammad, in the year 743 (1348). May Heaven constitute it a protecting bulwark, and reckon it among the lasting actions of the righteous!" We then enter the porch which winds along the barbican, and leads to the *Plaza de los Algibes*, or square of the cisterns. These are two in number, the largest of which is 102 feet long and 56 wide: it is arched over, and inclosed by a wall six feet thick. The principal arch is 47 feet wide in the centre, and is 17 feet below the ground: in these cisterns the water deposited its sediment, and was kept cool for the use of the castle.

On the east side of this Plaza is the Palace of Charles V., a beautiful specimen of the *cinque-cento* style, by the famous architect Alonsó Berrequete. On the north is a very simple and unostentatious entrance to the *Mesuar*, or common bathing court, the first of the Moorish palace. On entering it the visitor feels as if magically transported into one of the fairy palaces described in the *Arabian Nights*. The *Mesuar* is an oblong court 150 feet in length and 56 in width. It is paved with white marble, and the walls coverėd with arabesques of admirable workmanship. The inscription, *Wa la ghalib illa-lla*, that is, "God alone is conqueror." which is often repeated throughout the building, is read on the peristyles at each end of the court. In the midst of this court is a basin sufficiently large to swim in, bordered with parterres of flowers, beds of roses, and rows of orange trees. This court was designed as a common bath for servants and other dependants of the palace, and supplied with water the fountains of the other apartments.

At the lower end of the *Mesuar* is an archway leading to the *Patio de los Leones*, or Lion's court, which may be considered as the type of Arabian architecture. It measures 100 feet by 60, and is paved with white marble. In the centre of it is a large basin of alabaster supported by twelve lions, not in the best taste. Over this basin a smaller one rises, from which a large body of water spouts into the air, and falling from one basin into the other is sent forth through the mouth of the lions. This court is surrounded by a gallery supported by a great number of slender and elegant columns, 9 feet high, and 8½ inches in diameter. These columns are very irregularly placed, sometimes they are single and sometimes in groups of two or three. The walls, up to the height of 15 feet from the ground, are covered with blue and yellow mosaic tilings. The peristyles and ceiling are beautifully ornamented with arabesques and fret-work in the most exquisite taste. Around the upper face of the fountain of the lion are some Arabic verses, which describe in a style of oriental hyperbole the stupendous wonders and the marvellous beauty of the fountain.

On each side of the court projects a sort of portico or gallery, supported likewise with light marble columns.

On the left side of the court of the lions is the *Sala de los Abencerrages*, where the cicerone never fails to show the blood of these brave warriors, which, however, is nothing else but the deposit of the water impregnated with iron on the white stone.

Opposite to the *Sala de los Abencerrages*, on the other side of the court of the lions, is the *Sala de las dos Hermanas*, or Hall of the Two Sisters; so called from two huge flags of white marble, without a flaw or stain, which are in the pavement. On the upper end of the *Mesuar* arises the magnificent tower of Comares, so called from a delicate work named *comaragia*. This massive tower arises above the rest of the building, and overhangs a deep ravine, which descends almost perpendicularly to the Darro. The prospect from this tower is truly magnificent. The delightful valley through the Darro flows, part of the city of Granada and of its beautiful vega (plain), present an enchanting natural panorama. The *Sala de Comares* was undoubtedly the richest in the Alhambra, and still preserves traces of its past splendour. The walls are richly stuccoed and ornamented with arabesques of such exquisite workmanship, that the most skilful artists would be greatly embarrassed to imitate it. The ceiling is of cedar wood, inlaid with ivory, silver, and mother of pearl. The three sides of the hall are full of windows, formed in the immense thickness of the wall, which thus allow a free circulation of the air, and admit a faint light which produces a surprising effect. In the same manner all the halls of the Alhambra are lighted and ventilated.

On the east side of the *Sala de Comares* is the *Tocador de la Reina*, or Queen's Toilet; in a corner of this apartment there is a stone drilled full of holes, through which ascended the smoke of the costly perfumes burnt beneath. Close by is the charming little garden of Lindarajah with an alabaster fountain, and groves of roses, myrtles, and orange trees.

When we examine the halls of Alhambra, we are no less surprised at the elegance of their construction and the beauty of their ornaments than at the durability of a work of such a delicate nature. It appears, indeed, incredible that, after a lapse of nearly five centuries, its fountains should continue to play; the blue, the carmine, and the gold should preserve all their brilliancy and freshness; its slender columns and apparently fragile fillagree work should have stood the vicissitudes of time, and the terrible shocks of earthquake to which this place is subject.

THE PLYMOUTH BREAKWATER.

The south-west corner of Devonshire is admirably suited for a great naval station. Few portions of our coasts equal it in the facilities offered

for works of such a description. Plymouth Sound may be viewed as an estuary to the Tamar and the Plym. At any rate, we there find a noble expanse of water, sheltered in on the east, west, and north from winds and storms. As we approach the northern portion of this harbour or sound, we find it narrowed by the promontory of Mount Batten on the east, and the still bolder promontory of Mount Edgecumbe on the west. Arrived at the northern limit, where the citadel and Hoe of Plymouth form a termination to the Sound due northward, we find the inlet of the Catwater in the north-east, leading to the quays of Plymouth and the river Plym; while in the north-west we have the remarkable passage or strait between Cremill Point and Mount Edgecumbe. Having passed through this strait, we come at once into the magnificent harbour of the Hamoaze, where a secure anchorage is found for whole fleets of men-of-war; here, too, are seen the extensive works of the Devonport Dockyard, Victualling-yard, Steam Dock, and other government establishments. Proceeding onward towards Saltash, we come to the River Tamar, the lower portion of which is so broad as to form a harbour for three miles. The bays and inlets all around and within the Sound and the Hamoaze are so numerous as to afford remarkable facilities for the construction of works connected with ship-building, fortifications, naval defence, and maritime commerce.

The Breakwater, represented in the accompanying engraving, demands to be noticed. A truly great work is this; perhaps the greatest work of its kind in the world. It seems strange to spend a million and a half sterling in throwing huge stones into the sea; yet there can be no question that the money has been well laid out, because safety to hundreds of vessels has been secured thereby.

In order to understand the necessity for and the nature of this Breakwater, we must look a little closely at Plymouth Sound. This Sound is bounded on the east by a portion of the Devonshire coast, on the west by the Cornish coast, on the north by the towns of Devonport and Plymouth, and on the south by the open sea. It is three miles across at the widest part, and about the same in depth. The coast on both sides, except at Cawsand Bay, which is on the Cornish side, is rocky and abrupt. The Hamoaze and the Catwater used to be exposed to the heavy sea which rolled into the Sound with gales from the south, and great damage was done at various times; hence it was conceived that, if a great embankment were thrown across a portion of the entrance to the Sound, it would break the force of the sea, while ample room might be left at the two ends for vessels to enter and quit the Sound. In 1812 the works for such a breakwater were commenced, and for nearly forty years they have been continued. The expenditure has now reached within a fraction of £1,500,000, and there is still a little more work to be done to it.

The Breakwater may be thus described:—It is a straight line of stonework, with two wings or arms inclined a little inwards towards the Sound. The straight portion is about 1,000 yards in length, and the two wings 350 yards each; making up the total length to about a mile. The width of the line of stonework at the bed of the sea varies from 300 to 400 feet; whereas it slopes so rapidly upwards that the breadth at high-water mark is only fifty feet. The top is a flat horizontal surface, elevated a small distance above the surface of the water. The total depth varies from forty to eighty feet. The mode of forming it was singular. Mr. Rennie formed the plan, and carried it out in spite of all opposition and difficulties. This plan consisted in hurling into the sea masses of stone weighing from one ton to ten tons each, sufficiently heavy to resist the force of waves, tides, and currents. A promontory of compact close-grained marble, belonging to the Duke of Bedford, was purchased as a storehouse of materials for the sum of £10,000. This promontory is situated at the north-east corner of the Sound, at a place called Oreston, where the Plym joins the Cat-water. Quarries were opened at this spot, and for many years the business of quarrying was carried on. When Baron Dupin was visiting the naval depots of England, he was struck, among other things, by the magnitude of the operations at Oreston. He says—"The sight of these operations (which he had just described); those enormous masses of marble which the quarrymen strike with heavy strokes of their hammers; and those ærial roads of flying bridges which serve for the removal of the superstratum of earth; those lines of cranes all at work at the same moment; the trucks all in motion; the arrival and the loading and the departure of the vessels; all this forms one of the most imposing sights that can strike a friend of the great works of art. At fixed hours, the sound of a bell is heard, in order to announce the blasting of the quarry. The operations instantly cease on all sides, all becomes silence and solitude; this universal silence renders still more imposing the noise of the explosion, the splitting of the rocks, their ponderous fall, and the prolonged sound of the echoes." The huge blocks of marble, extricated from the quarries, were conveyed in trucks along iron railways to quays, where they were received in vessels built expressly for this purpose. On arriving over the line of this Breakwater, a sort of trapdoor was opened in the vessel, and the load of stone fell into the sea, where it lay upon and among the stones previously thrown. Thus days, weeks, months, years, passed away while these Herculean works were being carried on. All the lower stones were left to settle as they might: but the upper layers consist of smooth masonry, better calculated to resist the reaction of waves. At the western end is a lighthouse, an elegant structure of granite, recently completed; it is about fifty-five feet high, by fourteen feet in diameter at the base; at the top is a large lantern, through which is exhibited a white light towards the north, and a red light towards the south.

Bravely has the Breakwater done its work. In 1817 and 1824 it was visited by storms which, had not the Breakwater been there, would have brought awful destruction on the vessels within the harbour; as it was, some of the surface stones were loosened and washed away, but the main structure remained wholly uninjured. The value of the Breakwater is wholly shown by negative results: ships are not now driven on shore within the Sound and Hamoaze; but this negative result has a very positive effect on the national resources, one for which we may thank the Admiralty and Sir John Rennie.

HALOS.

That singular appearance often observable round the moon, is called a halo, and is a sure sign that we shall soon have rain. This peculiar phenomenon is caused by fine rain which is suspended in the upper regions of the air. Sometimes a halo is observed round the sun; but as the light of that orb is too dazzling for the eyes, solar halos are not so frequently observed as lunar halos, unless when the image of the sun is seen in still water, or in a mirror blackened at the back. Solar, or sun halos, arise from the same cause as lunar halos; and when we observe one of the former, we may be certain that we shall have a fall of rain that will last for four or five hours.

When the sky is invested with light clouds, we observe complete, or only portions of luminous rings round the sun; sometimes these are faintly, and at others strongly coloured, having all the bright hues of the rainbow.

To illustrate it more simply, cover a sheet of glass with lycopodium seed, and then when you look through it at the flame of a candle, you will observe a halo, the small particles of seed taking the place of the vesicles of vapour, which interfere with the rays of light in the same manner as the minute particles of seed.

Halos do not always assume the same form, and they also differ in colour. For example, when Captain (Sir E.) Parry was in the Arctic

regions, he observed and measured several halos, and upon one occasion he noticed one of these curious luminous discs like a very large wheel of light suspended in the heavens; the sun occupying the centre of it.

Many remarkable halos have been noticed by eminent scientific men from time to time but the simplest form of the halo is that of a white concentric ring round the sun or moon, caused by the small globules of vapour, which are said to vary about from $\frac{1}{5000}$th of an inch to $\frac{1}{50000}$ of an inch in diameter.

Halos are observed in various climates, from the Arctic to the Antarctic regions. Humboldt observed a curious lunar halo at Cumana, another at Mexico, and one between latitude 15° at the equator. In our own climate many remarkable examples of this singular optical phenomenon have been frequently observed, sometimes singly, and at other times associated with parrhelia, or mock suns, which occur in the vicinity of the great luminary.

Many theories have been framed and placed before the scientific world, endeavouring to explain the formation of halos; but for the most part they have failed, and we are now puzzled by two; 1st, that of Mariotte; and 2nd, that of Fraunhofer and Sir John Leslie. The first supposes that the phenomenon arises from the refraction of light passing through small particles of ice or snow, floating in the higher regions of the air: and the other two consider that it is the *deflection*, and not refraction of light, in passing by the small globules of water suspended in the upper regions of the air. Both these theories have strong advocates; but the latter appears the more correct, because halos are often observed when there are not any particles of ice or snow suspended in the atmosphere.

EDDYSTONE LIGHTHOUSE.

From the earliest times it has been customary to maintain, on exposed promontories or projecting angles on the sea coasts, buildings or beacons, in which fires were kept burning during the night, to guide the mariner on his way, and enable him to escape the dangers of the lee-shore—and in the days when men steered almost entirely by landmarks, and the merchant ship hugged the coast from the commencement to the end of the voyage, such lighthouses were necessarily numerous. They usually consisted of a solid tower of masonry, surmounted by a kind of iron cage, wherein was burnt inflammable materials of various kinds, chiefly logs of wood or old ropes, smeared with pitch to increase the flame. Two lighthouses of ancient times, however, were of a less primitive construction, and deserve particular mention; these are, the Pharos of Alexandria, and the Colossus of Rhodes.

The Alexandrian lighthouse was built on a little island near the city, about 280 years B.C., in the reign of Ptolemy Philadelphus. Strabo, whose account by the way exhibits a frequent tendency to exaggeration, tells us how the cunning architect, Sostratus, inscribed on the plaster coating of the Pharos, "King Ptolemy, to the gods, the preservers, for the benefit of sailors," after having first carved his own name on the solid stone beneath. The height is stated at four hundred feet; and the light, it was said, was visible at sea at a distance of forty miles.

The Colossus of Rhodes was a brazen figure, bestriding the entrance of the harbour. Its size was so great that a ship could sail between its legs. About the year 220 B.C. an earthquake shook it from its foundation, and partly destroyed it; but more than six hundred years after our Saviour's birth the brass of which the statue had been made was sold to a Jewish merchant for what was in those days an enormous sum.

The tower of Corduan, on a reef of rocks at the mouth of the Garonne, is the first lighthouse of modern times that merits especial mention—till then the contrivances for warning mariners from shoals had been rude enough, sometimes consisting merely of an iron basket of fire at the top of a pole. The Corduan tower, on the contrary, is a handsome building, nearly two hundred feet high, containing a complete suite of apartments, wardrobes, and even a chapel, where mass could be performed. At first oak wood was burned in a kind of brazier, in a stone lightroom, the smoke escaping through the unglazed sides; but after about a hundred years' service (the tower having been completed in 1610), it was found necessary to build an iron lightroom instead of the stone one; pit coal was used instead of timber, and other improvements were gradually introduced, until now, the voyager passing the mouth of the Garonne sees a brilliant light from Fresnel's beautiful apparatus shining out towards him, with promise of safety and good comfort.

The Mediterranean shores are dotted with lighthouses, many of them relics of the earlier parts of the middle ages. Few of them have participated in the march of modern improvement. At Civita Vecchia, Malta, Malaga, Genoa, Leghorn, and in many other cities, may be seen specimens of these mediæval lighthouses.

Turning from the Continent to England, we find lighthouses on the British coasts, under the control and management of the Trinity House. This institution was originally a corporation of seamen, its object being to advance the science of navigation as applied to the Channels leading into the Thames, and that river itself. Henry VIII. gave authority to certain mariners to found a fraternity in the parish church of Deptford Stroud, in Kent; and his daughter Elizabeth placed under the care of this fraternity "all beacons, landmarks, and signs for the sea." The act tells how steeples, woods, and other coast marks had been destroyed. "whereby divers ships had been lost, to the great hurt and detriment of the common weal, and the perishing of no small number of people," and threatens with a penalty of £100 all further depredators.

In the reign of James I. Lord Bacon decided, rather to the chagrin of the patent-selling king, that lighthouses came within the meaning of the Trinity House charter, as signs and landmarks. This sensible decision was partly set aside, and lighthouses were leased to private individuals, "to the great detriment," as the old act would have said, "of the common weal." In the reign of William IV., the entire number of lights on the coast were once more placed under the control of the Trinity House. They amount to about ninety.

The building of the first beacon on the Eddystone rocks forms an epoch in the history of lighthouses.

The Eddystone rocks, situated about fourteen miles from Plymouth, in the direct path of homeward-bound ships steering up Channel, had long been looked upon with dismay by captains and mates; they extended about 600 fathoms across the Channel, in a south-west direction, and were exposed to the full force of the heavy swells from that quarter. At high water, moreover, they were often completely covered. In rough weather the rocky barriers frequently lashed the sea with such fury, that waves leaped up into the air to the height of thirty and forty feet. The currents, too, in this part of the Channel are very variable; so that the most careful of captains, after escaping all the perils of a homeward voyage from India, would not unfrequently lose his ship on the terrible Eddystone, within a week's sail of the port of London.

Till 1699 no attempt was made to decrease the dangers of Channel navigation by the establishment of a light on the Eddystone rocks; but in that year an ingenious person was found who, after many efforts, successfully carried out the work.

Henry Winstanley, the constructor of the first Eddystone lighthouse, was the kind of man whom the world would call an eccentric genius. His house and garden, at Littlebury, in Essex, were full of strange contrivances for astonishing visitors. There was, for instance, a summer-house in the garden, by the side of a lake; the visitor who stepped into this retreat would suddenly find himself floating away from land;—if on passing through the hall he kicked aside an old slipper that lay in his way, a spectral figure started up before him. Everything that Winstanley did displayed a mixture of ingenuity and whim; and the building he erected on the Eddystone was no exception to the general rule.

The construction of the building occupied four years—much time being wasted in journeys to and from Plymouth, and many days lost through stormy weather and similar contingencies. It was built in the form of a polygonal column, eighty feet high, and consisted of a store-room, with a projecting cabin to the south-east, a kitchen, a state room, a lodging room, an open gallery or platform, an attending or look-out room, and a lantern surrounded by a gallery. Much care had been taken to strengthen the works, for the force of the sea proved tremendous. Many times the light was completely buried beneath the waves; and in a hard gale, it was said, a six-oared boat might have been carried by the waves through the open gallery round the lantern. But Winstanley was confident in the strength of his work; and when, in November 1703, he came to superintend some operations, his friends hinted to him their apprehensions of danger, he replied, "he only wished he might be there in the greatest storm that ever blew under the face of heaven." Too soon, alas! the presumptuous wish was granted.

The 26th of November, 1703, was long remembered in England as the date of the "great storm." Never had our coasts been visited by so devastating a gale; the fleet, the merchant shipping, and the seaport towns and villages, all suffered alike: trees were torn up by the roots, and heavy chimneys were sent whirling over the housetops like straws. There was ruin, and destruction, and wailing everywhere.

At dawn on the morning of the 27th, many people were seen looking anxiously out in the direction of the Eddystone rock. But there was no lighthouse left on the storm-beaten reef: Winstanley, his workmen, his light-keepers, and the building he had raised with so much pains and labour, had all perished together; and a large Indiaman, the Winchelsea, had struck upon the rock where no beacon light now shone, and nearly the whole of her crew had perished.

Three years after this calamity, it was resolved that another lighthouse should rise on the Eddystone rock, and a Captain Lovet obtained a lease for ninety-nine years from the Trinity House upon undertaking the management of the affair. As his architect and engineer, he chose a man whose industry had till then been displayed in quite a different direction; and the second Eddystone lighthouse was erected by John Rudyerd. a silk mercer, of Ludgate Hill.

Rudyerd, however, fully justified the confidence placed in him. His lighthouse was in every respect a great improvement on Winstanley's. Instead of the polygonal, he chose the circular form, as offering less resistance to the force of the waves. He carefully avoided everything like a projection in the walls, except a parapet immediately below the lantern. The rock was cut into layers or steps, and the foundation, of alternate layers of granite and timber, securely fastened by iron clamps. The building itself was of well-seasoned timber, strong and massive. Two light-keepers were appointed to watch the light four hours, alternately. Afterwards their number was increased to three, for one of them was taken ill suddenly in stormy weather, and died. His companion was in a dreadful state of perplexity. He dared not throw the body into the sea lest suspicions of foul play should be excited against him. He hoisted a flag as a signal to the people of Plymouth; but the weather was so boisterous that no boat could come near the rocks. After a fortnight's horrified suspense, relief at length came; the dead body was committed to the deep, and for the future three light-keepers were employed, with permission to spend a month on shore, alternately. During the war with France, a French privateer once took away the workmen and their tools from the Eddystone rock and carried them into a French port, expecting to be rewarded for the capture; but Louis XIV., to his honour, released them and sent them back to their work, observing that the Eddystone lighthouse was a benefit to all nations alike.

After braving the fury of the channel storms for forty-six years, Rudyerd's lighthouse was destroyed by fire. It was never distinctly known how the fire began; only that it originated somewhere near the top of the lantern, and burned downwards. The poor lightmen were in great peril of their lives, and had to retreat downward, step by step, as the fire advanced. At last they managed to creep into a little cave in the rock; and were rescued with great difficulty by two boats, eight hours after the fire broke out, and carried into Plymouth;—strange to say, immediately on their arrival, one of the men made off, and was never heard of afterwards.

Another of the lightmen was found, on reaching the shore, to be seriously ill, and he persisted in declaring that he had swallowed a portion of melted lead from the roof, as he was looking up to throw a pail of water on the fire. This tale was looked upon as impossible; but the poor fellow died, some days afterwards, and on a post mortem examination, a piece of melted lead, seven ounces in weight, was found in his stomach.

All that remained of Rudyerd's lighthouse was an iron clamp or two, firmly embedded in the rock; but the usefulness of the work, and the danger of leaving the rock without a beacon, were now fully recognised; and immediate application was made to the Royal Society, to recommend a competent engineer to undertake the great national work. The Society replied by recommending one of their own number—John Smeaton.

This remarkable man, who afterwards became known as one of the first engineers of his time, was only in the beginning of his career, when, in 1755, the reconstruction of the Eddystone Lighthouse was entrusted to his care. The rebuilding of that valuable edifice was only the first of a series of works which remain as monuments of his energy and skill.

The chief advantage in the new lighthouse consists in its being built entirely of stone. Some opposition was at first offered to the new plan. The objectors talked of the elasticity of Rudyerd's lighthouse, as having constituted its chief safeguard, alleging, in support of their opinion, that during storms the vibration had been so great as to throw down dishes and plates from shelves and tables in the upper rooms. Smeaton, however, satisfactorily proved that this boasted elasticity had simply been want of strength, arising from want of weight; and at length his hearers were convinced that the vibration, instead of being an advantage, was a positive drawback, and tended to destroy the security of the building.

In the face of many disappointments and delays, the work was brought to a conclusion, and on the 16th of October, 1759, four years after the commencement of Smeaton's work, a light once more shone over the deep from the Eddystone rock. Several accidents had occurred to the projector himself. Once, while walking with praiseworthy exultation on the level stone platform erected during the first year of his labours, he made a false step, and fell completely over the side of the causeway on to the jagged rock beneath, dislocating his thumb, and seriously bruising himself. With characteristic energy he set the dislocated joint, without surgical help, and resumed his work, though he felt the effects of the accident for six months afterwards. Another time he nearly lost his life by sitting down with some of the workmen in the upper storeroom, where a pan of charcoal had been placed for the purpose of heating some iron bars. The fumes of the charcoal rendered Smeaton insensible and it was only by dint of great exertion that he was restored to consciousness.

Even Smeaton was astonished at the force with which the sea broke over the lighthouse in a storm, during which he gazed at his work through a telescope from Plymouth, but the lighthouse soon proved itself able to bear the severest brunt of the Channel storms, and the light-keepers quite rejoiced in the strength of their sturdy castle.

THE BRITANNIA TUBULAR BRIDGE.

This is one of the most remarkable structures in the world, the design of the celebrated architect, Sir R. Stephenson. This bridge is on the line of the Chester and Holyhead Railway, crossing the Menai Straits, within

sight of Telford's Chain Suspension Bridge. It is made of cast iron of a tubular form, in the tube of which the railway passes. Four of these span the Strait, and are supported by piles of masonry; that on the Anglesea side is 143 feet 6 inches high, and from the front to the end of the wing walls is 173 feet. These wing walls terminate in pedestals, on which repose colossal lions of Egyptian character. The Anglesea pier is 196 feet high, 55 feet wide, and 32 feet long. In the middle of the Strait is the Britannia Rock, from which the bridge derives its name; on this the Britannia pier is raised. It is equally distant from the Anglesea and Caernarvon piers, being 460 feet in the clear from each, and sustains the four ends of the four long tubes, which span the distance from shore to shore. There are two pairs of short and two of long tubes, the lengths of these pairs being 250 feet and 470 respectively. The Egyptian lions are 25 feet 6 inches long, 12 feet 6 inches high, 8 feet wide, and weigh 80 tons. Two thousand cubic feet of stone were required for each lion. The total quantity of stone in the bridge is 1,400,000 cubic feet. The weight of malleable iron in the tubes is 10,000 tons, of cast iron, 1,400 tons. The whole length of the entire bridge, measuring from the extreme front of the wing walls is 1,833 feet, and its greatest elevation at Britannia pier, 240 feet above low-water mark. The total cost of the structure is £601,865. This wonderful structure was begun April 13th, 1846, and completed July 25th, 1850: open for traffic October 21st, 1850.

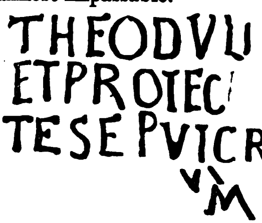
Before the bridge was allowed to be used for the conveyance of passengers and merchandise, it was subjected to very severe tests. The first and principal experiment consisted in passing two locomotive engines through the tube, and resting them at intervals in the centre of the sections. Another trial was a train of twenty-eight wagons and two locomotives, with 280 tons of coal, drawn into all four of the tubes, the deflections being carefully noted. These deflections, in every case, by means of a nice apparatus for the purpose, were ascertained to be exactly three fourths of an inch over the immense mass and area of iron.

Some of the acoustic effects produced by the bridge are curious. The report of a pistol fired beneath it is repeated three or four times. The cells of the top and bottom form excellent speaking tubes; and, by elevating the voice, persons may converse through the entire length of the bridge, more than 500 yards. If one end of the cells be closed they return a powerful echo; but, although a whisper is thus distinctly repeated, the loudest whistle does not appear capable of returning any echo.

THE CATACOMBS OF ROME.

Amid the ruins of stately temples, and numerous remains of the "Eternal City," there are no objects which have such great and general interest as the subterranean churches, dwellings, and places of sepulchre of the early Christians, which perforate, by a net-work of excavations, the neighbourhood of Rome.

The great increase in the extent and magnificence of Rome during the times of the Republic, led to the formation of quarries in the surrounding parts. The peculiar nature of the soil has caused the excavations to be made in a manner similar to that used in the working of coal, iron, stone, lime, &c. The useful material has, in fact, been cleared away, leaving long ranges of dark caves and passages. After the stone had been removed from these underground quarries, it was, for many centuries, customary to work out the sand for the purpose of making cement. Vitruvius has stated that the sand obtained from the Esquiline pits was preferable to any other. Ultimately the quarries and sandpits extended to a distance of upwards of fifteen miles on one side of Rome. Parts of this large range of excavations were from time to time used as burial-grounds by such of the Romans as could not afford the cost of burning the bodies of their dead relations. And, in addition, the Esquiline hills became infested by banditti, and were from these various causes rendered almost impassable.



In course of time the catacombs became, with the exception of one or two, neglected and filled up with rubbish, and remained for a period of upwards of one thousand years untouched and almost unknown. In the sixteenth century the whole range of the catacombs were reopened, and numerous inscriptions and other matters connected with the struggles and hardships of the early Christians brought to light. The annexed brief memorial will show the general style of the lettering.

In these excavations, it is said, that not only persons, but cattle, contrived to support existence; and although it was well known that large numbers were lodged in these dismal dwellings, their intricacy and numberless entrances rendered them a comparatively secure retreat. It is related that attempts were made to cover the galleries with earth, in order to destroy those who were concealed within; but this is too un-

charitable a view to be accredited, and we should pause ere we give belief to so horrible a relation.

CASCADES DES PELERINES.

There is a waterfall in Chamouni which no traveller should omit going to see, called the Cascade des Pelerines. It is one of the most

curious and beautiful scenes in Switzerland. A torrent issues from the Glacier des Pelerines, high up the mountain, above the Glacier du Boissons, and descends, by a succession of leaps, in a deep gorge, from precipice to precipice, almost in one continual cataract; but it is all the while merely gathering force, and preparing for its last magnificent deep plunge and recoil of beauty. Springing in one round condensed column out of the gorge, over a perpendicular cliff, it strikes at its fall, with its whole body of water, into a sort of vertical rock basin, which one would suppose its prodigious velocity and weight would split into a thousand pieces; but the whole cataract, thus arrested, at once suddenly rebounds in a parabolic arch, at least sixty feet into the air; and then, having made this splendid airy curvature, falls with great noise, and beauty into the natural channel below. It is beyond measure beautiful. It is like the fall of divine grace into chosen hearts, that send it forth again for the world's refreshment, in something like a shower and spray of loveliness, to go winding its life-giving course afterwards, as still waters in green pastures. The force of the recoil from the plunge cf so large a body of water, at such a height, is so great, that large stones, thrown into the stream above the fall, may be heard amidst the din, striking into the basin, and then are instantly seen careering in the arch of flashing waters. The same is the case with bushes and pieces of wood, which the boys are always always active in throwing in, for the curiosity of visitors, who stand below, and see each object invariably carried aloft with the cataract, in its rebounding atmospheric gambols. When the sun is in the right position, the rainbows play about the fall like the glancing of supernatural wings, as if angels were taking a shower-bath. If you have "the head and legs of a chamois," you may climb entirely above this magnificent scene, and look out over the cliff right down into the point where the cataract shoots like the lightning, to be again shot back in ten thousand branching jets of diamonds.

MONSOONS.

These are periodical winds which blow over the Indian ocean, between Africa and Hindustan, for nearly six months, from the north-east, and during an equal period from the south-west. The region of the monsoons lies a little to the north of the northern border of the trade-winds, and they blow with the greatest force and with most regularity between the eastern coast of Africa and Hindustan. When the sun is in the southern hemisphere, a north-east wind, and when it is in the northern hemisphere, a south-west wind blows over this sea. The north-east monsoon blows from November to March. It extends one or two degrees south of the equator. It becomes regular near the coasts of Africa sooner than in the middle of the sea, and near the equator sooner than in the vicinity of the coasts of Arabia. This wind brings rain on the eastern coasts of Africa. The south-west monsoon does not extend south of the equator, but usually begins a short distance north of it. It blows from the latter end of April to the middle of October. Along the coast of Africa, it appears at the end of March; but along the coast of Malabar, not before the middle of April; it ceases, however, sooner in the former than in the latter region. The rainy season on the west coast of Hindustan commences with the first approach of the south-west monsoon. The monsoons prevail also on the seas between Australia and China.

The effect of the struggle which precedes the change in the direction of the wind in this part of the world is thus described in "Forbes's Oriental Memoirs." The author was encamped with the English troops:

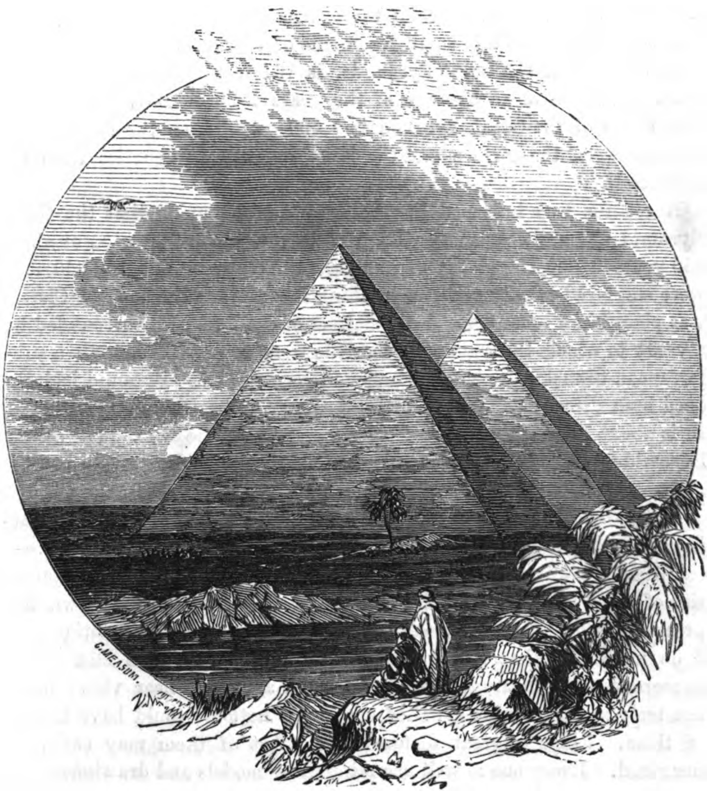
"The shades of evening approached as we reached the ground, and just as the encampment was completed, the atmosphere grew suddenly dark, the heat became oppressive, and an unusual stillness presaged the immediate setting-in of the monsoon. The whole appearance of external nature resembled those solemn preludes to earthquakes and hurricanes in the West Indies, from which the East in general is providentially free.

We were allowed very little time for conjecture. In a few minutes the heavy clouds burst over us. I had witnessed seventeen monsoons in India, but this surpassed them all in its awful appearance and dreadful effects. Encamped in a low situation on the borders of a lake formed to collect the surrounding water, we found ourselves in a few hours in a liquid plain; tent-pins giving way in a loose soil—the tents fell down—and left the whole army exposed to the contending elements. It requires a lively imagination to conceive the situation of a hundred thousand human beings of every description, with more than two hundred thousand elephants, camels, horses, and oxen, suddenly overwhelmed by this dreadful storm in a strange country, without any knowledge of high or low ground, the whole being covered by an immense lake, and surrounded by thick darkness, which rendered it impossible for us to distinguish a single object except such as the vivid glare of the lightning occasionally displayed in horrible forms. No language can adequately describe the wreck of a large encampment thus instantaneously destroyed, and covered with water, amid the cries of old men and helpless women, terrified by the piercing shrieks of their expiring children, unable to

afford them relief. During this dreadful night more than two hundred persons and three thousand cattle perished miserably, and the morning dawn exhibited a shocking spectacle—one not easily realized by the most vivid imagination. And the fears and tortures of the expiring, who shall paint them!"

THE PYRAMIDS OF EGYPT.

The Pyramids of Egypt, especially the two largest of the Pyramids of Jizeh, are the most stupendous masses of building, in stone, that human labour has ever been known to accomplish. The Egyptian Pyramids, of



which, large and small, and in different states of preservation, the number is very considerable, are all situated on the West side of the Nile, and they extend, in an irregular line, and in groups, at some distance

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from each other, from the neighbourhood of Jizeh, in 30 degrees N. lat., as far south as 29 degrees N. lat., a length of between 60 and 70 miles. All the Pyramids have square bases, and their sides face the cardinal points.

The Pyramids of Jizeh are nearly opposite to Cairo. They stand on a plateau or terrace of limestone, which is a projection from the Lybian mountain chain. The surface of the terrace is barren and irregular, and is covered with sand and small fragments of rock; its height, measured from the base of the Great Pyramids, is 164 feet above the Nile in its low state, taken at an average of the years 1798 to 1801. The north-east angle of the Great Pyramid is 1,700 yards from the canal which runs between the terrace and the Nile, and about five miles from the Nile itself.

Herodotus was informed by the priests of Memphis that the Great Pyramid was built by Cheops, King of Egypt, about 900 B.C., or about 450 years before Herodotus visited Egypt. He says that 100,000 men were employed twenty years in building it, and that the body of Cheops was placed in a room beneath the bottom of the Pyramid, surrounded by a vault to which the waters of the Nile were conveyed through a subterranean tunnel. A chamber under the centre of the Pyramid had indeed been discovered, but it does not appear to be the tomb of Cheops. It is about 56 feet above the low-water level of the Nile. The second Pyramid was built, Herodotus says, by Cephren, or Cephrenes, the brother and successor of Cheops; and the third by Mycerinus, the son of Cheops.

Lord Nugent, in his "Lands, Classical and Sacred," gives an interesting account of his visit to the Pyramids of Egypt, which we extract:—

"Most travellers profess to have been disappointed with the apparent size of the Pyramids at their first approach. I speak of my own impressions only. I will not say that they surpassed my expectations, for I do not know that I had formed any very determinate idea of the appearance of such stupendous masses of masonry at near view; but I can truly say they quite equalled any vague notion I could have formed of them. From a great distance the effect of them may easily be imagined. Every one is well acquainted, by models and drawings, with their general form, and, while they are too far off for objects near them to be visible with which the eye can contrast their size, every one may well judge how they must appear. From the Nile, opposite the apex of the Delta, from whence you first catch sight of them at nine miles off, you acknowledge them as things you are well acquainted with, and for which for some hours of your passage up the Nile, you had been on the look-out. They have much the same appearance from the heights of the Moccatam, or from Old Cairo. But, as you near them on the remains of the old causeway, you are overcome with a sense of their exceeding bulk and grandeur.

"The table-land of stone, 150 feet above the surrounding level, and from which the sides of the Pyramids spring, adds much to their commanding appearance as you approach them. At the distance of a mile or so, you hardly distinguish this great pedestal or platform from the flat desert of the same colour, extending to the horizon behind it.

"I visited the Pyramids several times; the first time with Lord Mountcharles and his fellow-travellers. On that occasion we were unable to proceed in the Great Pyramid further than what is called the King's Chamber, which is at the end of the horizontal passages and the inclined galleries, up which is the access between them. We had neglected to provide ourselves with a ladder, which is necessary for those who would mount hence into the four upper chambers. I was therefore obliged to postpone this to my second visit.

"However worthy of description the interior of this Pyramid is, in all its details,—the ascent of the great gallery at some 230 feet from the entrance, and that magnificent vault to which it leads, the King's Chamber, lined throughout with polished granite, and the great sarcophagus at the further corner of it,—that deep and mysterious well at the lower end of the gallery, explored through its three gloomy shafts by the adventurous and gallant perseverance of Mr. Davison, and half a century after by M. Caviglia,—and the smaller passage that branches off into the Queen's Chamber, 498 feet in a perpendicular line below the apex of the Pyramid,—all these have been so thoroughly and minutely described in the works of Colonel Vyse, and Sir Gardner Wilkinson, and Dr. Russell, as to forbid repetition. Their labours, and those of all who preceded them, have left, perhaps, little further to be discovered; nothing certainly which has been discovered, undescribed. It is, however, worth observation that, of all the measurements made of the sarcophagus, there are hardly any (I know but of two, Dr. Russell's and Colonel Vyse's) which exactly, and to an inch, agree. They make the breadth of it three feet three inches; and Sir Gardner makes it only three feet. We measured it, as we believed, with scrupulous exactness, making its breadth three feet two. Other descriptions also vary in this respect. This discrepancy as to the three inches makes all the difference in the question respecting the manner in which this Pyramid was constructed. If Sir Gardner's measurement, the smallest, be the correct one, it admits the possibility of the sarcophagus having been introduced by levers or screws all along the passages, and through a door of the chamber where it is placed. If, on the other hand, three inches, or two and a-half, be added, this is impossible, and the sarcophagus must, it appears, have been deposited here while the floor on which it stands was open to the upper air, and all the remaining superstructure of the Pyramid have been afterwards built over it.

"To Colonel Vyse the merit is due of detecting the real purpose of the two small apertures in the side walls of this chamber. He has established beyond doubt that these were designed for ventilators. Having discovered two holes on the outside of the Pyramid, one in the north face and the other in the south,—that to the north being exactly halfway up from the great entrance to the apex, and the other directly opposite; he found, I believe, by pouring coloured water down, that they communicated with these interior ones.

"The mouth of the first and outer passage of the Great Pyramid is in its northern face, at a little less than a ninth part of the way up the outer ascent. Above the square entrance are two huge blocks of stone, resting against each other in an angle of some sixty degrees, and forming a kind of pediment,—for the purpose, as is supposed, of a support to the weight of masonry above. In one corner of this pediment, Professor Lepsius has—if it may be allowed to say so of so learned and able a man—with a somewhat questionable taste, carved out a tablet, and adorned it with a long and doubtless very correct hieroglyphic inscription, in honour of his Sovereign King William of Prussia, and of Victoria, Queen of England; strikingly inappropriate in that place—an anachronism both in character and composition—illegible to the great mass of mankind—and, to the few learned who can read it, a counterfeit, proclaiming itself to be such,—a line added to the Iliad in commemoration of Waterloo.

"The entrance of each of the three great Pyramids, and of such of the others as have been opened at Aboukir, Sakhara, and Dashour, is due north (polar, not magnetic); and the passage, leading straight from the mouth, descends in each at the same angle of about twenty-seven degrees from the plane of the horizon, which gives a line of direction not far removed from that point of the heavens where the Polar Star now crosses the meridian. Hence Dr. Russell, with great probability, attributes to the Pyramids, besides the other purposes for which they were designed, that of fixing the measurement of sidereal time by the observation of this or some other star passing the meridian across the mouth of a long tube thus adjusted to the proper point. Nor is this suggestion rendered at all less probable by showing that, probably at a very early time after the construction of the Pyramids, the mouths of these passages were carefully sealed with massive masonry. If the objects of these astronomical observations were in any way connected, as is by no means unlikely, with the religious rites of the Shepherd-Kings of Egypt, who closed the temples and discouraged the observances of the old Egyptian mythology, it is indeed in the highest degree probable that, on the restoration of the old worship under the Pharaohs, all access to places built with such an object should have been carefully prevented. It seems very clear that the Pyramids were designed for several other purposes besides that of royal sepulture. That of the gnomon, for determining the solstices, and for giving a scale of general measurement, on which so much has been written, and with so much learning, cannot be dismissed from consideration; nor can one fail to be struck with the reasoning in that very ingenious little tract of Mr. Agnew's, published in 1840, in which he shows, by diagram and calculation, how bold and near an approach was made, in the construction of these buildings, towards the quadrature of the circle.

"At all events, it seems strange that, notwithstanding all the speculations which have for so many ages been maintained by philosophers and antiquarians as to the history and intent of the Pyramids, almost all authorities are at variance on the question of fact as to the measurements of sides and angles. An agreement on this point, at least, if it did not lead at once to the true solution, might prevent much waste of time and disputation on improbable theories, and ought surely to be undertaken and established in such a manner as to leave no doubt as to the basis on which all, particularly the astronomical, hypotheses must be founded.

"The ascent of the Great Pyramid is accomplished with no difficulty and little labour. From the platform at its top, it need not be said, that the view is extensive and splendid; and, whether with respect to the great distance of the horizon all round, the unbroken circle it forms, and the mighty range of historical associations it contains, unlike any which any other height, natural or artificial, in the world can afford.

"Various inscriptions, principally names of travellers who have been here, are carved and painted on the platform and on the blocks of stone which stand upon it. Among other names is that of the Vicomte de Chateaubriand. He informs us, in his 'Itinéraire,' that, having been obliged to leave Cairo, on his return to France, without seeing the Pyramids, he delegated to M. Caffe, the French consul there, the following commission:—'Je chargeai M. Caffe d'ècrire mon nom sur ces grands tombeaux, selon l'usage, à la prèmiere occasion: l'on doit remplir tour les petits devoirs d'un pieux voyageur!' (vol. ii. p. 213). M. Caffe, it appears, very naturally declined the vicarious performance of this little duty of a pious traveller; to wit, the inscribing the Vicomte's name in testimony of his having been where he had not been. Some years afterwards, however, an English traveller thought it a little duty of his own to fulfil, uncommissioned, those intentions of the Vicomte's, which M. Caffe seems to have thought were best left unfulfilled. Accordingly, there is the name. But a French traveller since has trimmed the balance of truth, by writing in large letters beneath, 'Le Vicomte n'était pas ici.' And thus the record rests for the amusement of posterity.

"The interior of the second Pyramid of Cephren, laid open by the dauntless enterprise and industry of Belzoni, and since made more easy of access by Colonel Vyse, ought not to be left unvisited. I had not time enough left to me on the evening when I entered it, to do more than proceed hastily along the main passage, and the spaces where stood the two portcullises of granite described by Belzoni, into the chamber at the end, and view the fine sarcophagus which is partly let into its floor.

"No one ought to undertake to mount the outside of the second Pyramid who is liable to giddiness upon a height; the last 130 or 140 feet nearest the top being cased with a coat of smooth cement. Holes, it is true, are cut in this part for the hands and feet; but, in descending, you are obliged to look down the face of it sheer on the plain below, to see where the successive holes are in which to place your feet. At all events, it is advisable, 'si Monsieur n'a pas bonne tête,' that the Arabs, or any companion whose head may be trusted not to turn when at the top, should be provided with a rope to be made fast there, by which the gentlemen of doubtful nerves may descend with perfect safety and ease. Otherwise he may find himself in a difficulty, for which nothing during the ascent had prepared him.

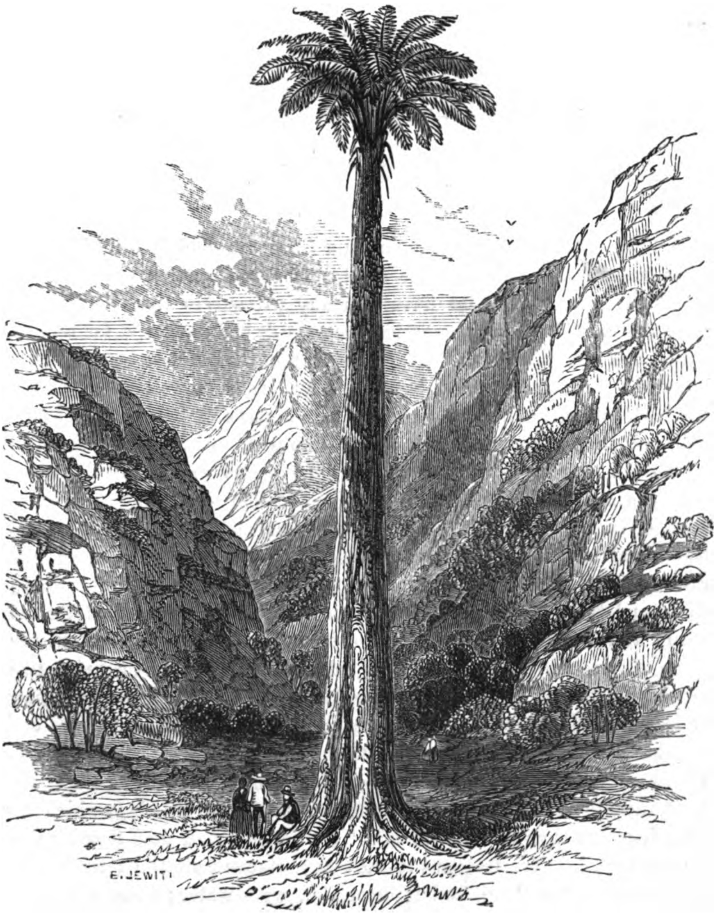
"The third Pyramid we had not time to enter. The whole of the outside of this Pyramid, as also of the first, and probably, also, of the lower part of the second, was faced with a thick layer of the Syenean red granite from Upper Egypt, fragments of which lie scattered over a large space around;—records of the attempts made in different ages by barbarous princes, some from a superstitious, others from an utilitarian motive, to destroy these mighty monuments. But their vastness, and the compact mode of their construction, enabled them to withstand the ravages of force, as they had withstood those of time, apparently without much reduction of their original dimensions; certainly without any visible damage to the symmetry of their proportions."

EXTRAORDINARY CATARACT.

In the island of Pulo Penang, in the Straits of Malacca, there is a cataract which is surpassed by very few in the four quarters of the earth. It is rarely visited, and, therefore, has been but seldom described; but, those who have been fortunate enough to witness it, all agree in the opinion that it forms one of the wonders of the world. The stream which supplies it is of considerable volume, and, after traversing a long tract of comparatively level country, is suddenly precipitated almost without a break into a ravine, nearly two hundred feet below the summit of the fall. The annexed engraving gives an excellent representation of the scene. The stream descends with a mighty roar, and rushes on with a lightning speed. If you take the trouble of bringing a small looking-glass in your pocket, and come here about an hour before noon, you will be able to produce some very beautiful artificial rainbows. But whatever you do never attempt to clamber to the top of the rocks, for though, doubtless, the scenery is very sublime up there, the pathway is slippery and dangerous in the extreme; and the guides can tell how two hapless youths, officers belonging to a regiment stationed here some twenty years ago, clambered up that hill, and how they shouted with triumph on reaching yon summit, and waved their handkerchiefs bravely; but they can also tell the gloomy and disastrous end of all this, how the wild screams echod far and wide, as both slipped and fell headlong into the surging torrent, and the sun shone brightly upon the bright red uniforms as they were hurried over the precipice, and dashed from rock to rock; and, whilst the yet horror-stricken spectators gazed

with speechless agony and terror, the bodies of the poor young men were borne away and hid by the blood-stained waters from human recovery.

GIANT TREE.



THERE are few trees in the world like the giant tree in the island of Pulo Penang, of which the annexed engraving is a correct representation. It is one of the various kinds of palm; and some idea may be formed of its height from the fact that it is twice as tall, and quite as straight, as the mainmast of a line-of-battle ship. There are no branches, twigs anywhere to be seen, save just at the very summit; and here they bend over gracefully, something like one would imagine a large-sized palm-tree to be, if gazed at through Lord Rosse's telescope. It is the only specimen of its kind to be met with in the whole island.

THE PALM.

We read that a certain Arab, when a European had described to him what nature and art had done for his favoured portion of the globe, asked the question, "And have you any palm-trees there?" and, on receiving a reply in the negative, expressed his contempt for a land which was without this, as it appeared to him the greatest boon which a bountiful Providence could bestow. This anecdote well demonstrates the high estimation in which the palm is deservedly held in the East; and not in the East only, but in all countries in which they flourish, which are chiefly within the tropics, the palms are regarded with a feeling almost approaching to veneration. Noble and stately in appearance, often the only green things in wide tracts of sterility, they attract the admiration by their beauty, and awaken feelings of love and gratitude for the benefits which they bestow; they give refreshing shade and shelter from the burning heat; they afford juicy food for the weary and hungry traveller, and his jaded horse or camel; and in the spots of verdure—those oases in the desert—from which they rise, like protecting deities, gush out the sparkling waters, which are, oh! how welcome to the thirsty ones, whose parched lips, panting breath, and blood-shotten, starting eyes, show that, but for a providential supply of this want of nature, they must soon have sunk down to perish in the wilderness! Of all the trees mentioned in Scripture, this it is which has most honour; thus we are told that "a righteous man shall flourish like a palm tree." Very frequent in the Old Testament are the references to it, and we often there find it associated with water; thus, when the Israelites journeyed to Elim, they came, it is said, "to a place where there were threescore-and-ten palm trees, and twelve wells of water." In the New Testament, likewise, it is sometimes spoken of, and generally as symbolical of something noble, or beautiful, or pure, or holy. So in Revelation, we read of the redeemed walking in heaven, carrying palm branches.

We might quote pages upon pages of tributary lines from the poets on this majestic tree; but our object is, just now, rather to speak of the economical uses of the different kinds of palms, which have been well called by Linnæus "the princes of the vegetable world," and which have obtained their generic name *Palma* from the supposed resemblance of their broad leaves to the human hand, *palma* being the Latin for the hand. On the same account, the date, which is the fruit of one species of palm, is called *dactylus*, a finger, not so much from its form, as from its growing in clusters, spreading out like the dactyal extremities :—

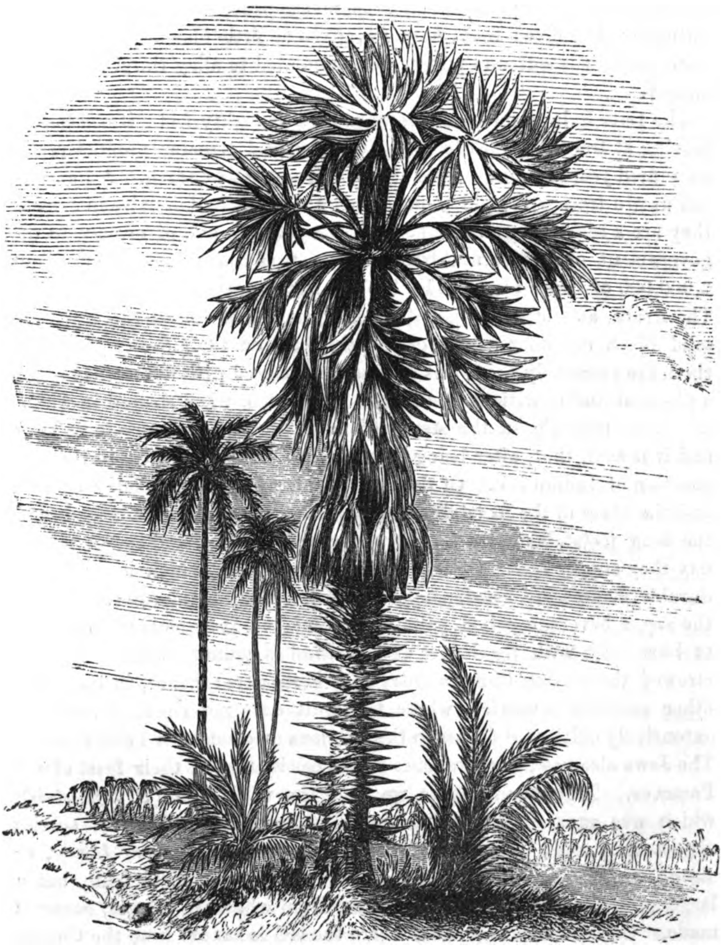
> "An emblem of that faith that cheers
> The pilgrim on his road,
> Through life's dark vale of care and tears,
> Beneath his earthly load.
>
> For, like that faith, alone it stands,
> A bright Oasis in the sands,
> With hand-like leaves against the sky,
> Pointing to immortality."

We will commence our brief account of this noble and useful family of plants with the Date Palm (*Phœnix dactylifera*), which is the tree alluded to in Scripture; it grows spontaneously throughout the whole of the East, as well as through the greater part of northern Africa, occurring but as a cultivated tree in the south of Europe. The Moors have a tradition that it was introduced into Spain by Abderrahman, one of their greatest conquerors, who wrote some verses on it, which they say "were known to everybody." Laborde, in his splendid work on "Arabia Petræa," gives a very fine representation of this magnificent tree, standing in solitary grandeur amid an amphitheatre of rock, its image reflected in the glossy pool from whence the Arab women are filling their pitchers. Describing the country, this author observes, "What appeared to me most worthy of notice was a palm tree in its natural state, which was found about Ouadi Seleh. The palm tree is always represented with its summit pointed, its leaves bent back, and spreading over its head, from whence hang dates as bright as coral; and we never imagine that all this elegance is produced by art, and that nature, less refined, has only attended to its preservation. Before we saw the palm tree, as it had grown for many a year, forming a rampart for its perishing leaves, and again coming to life, as it were, in the midst of its wreck. Neglected by the Arab of the desert, who considers all attempts at cultivation as beneath his dignity, the palm tree, at times, forms impenetrable forests; more frequently, however, it is found isolated, near a fountain, where it presents itself to the thirty traveller like a friendly lighthouse, pointing out to him the spot where water is to be found to quench his thirst, and a charitable shade in which to repose.

We should observe here that the growth of the palm is altogether different from that of other kind of trees, from which it differs materially in structure, although it sometimes reaches a very great height, the stem is always comparatively slender; it is not until after the lapse of several years that it shows any stem at all, and this, when once formed, does not increase in size, but pushes up, joint after joint, with merely a tuft of foliage at the top; each thickened ring denoting the falling off of the annual circle of leaves, so that the age of the tree can be easily computed. The first growth is somewhat similar to that of the fern, the leaves of the young plant arising immediately from the earth. The Date Palm, peculiar with its cylindrical, columnar stem, and crown of leaves, is a singularly graceful object in the deserts of the old world; so we read in Moore's "Lallah Rookh" of—

"The group of lovely date trees bending
Languidly their leaf-crown'd heads,
Like youthful maids, when sleep descending,
Warns them to their silken beds."

Respecting the fruit of this tree, we may observe that, what rice is to the most fertile parts of Asia, that are dates to Africa; the tree which bears them is found in every country, from the Tigris to the Atlantic; and it supplies millions of human beings with their daily food in Arabia, and in nearly the whole of Africa north of the Equator. In many parts of the great African Desert, it is, indeed, unable to bear fruit; but, naturally, it is a very hardy plant, and produces dates in such profusion, that, towards the north of the Sahara, they are eaten not only by man, but also by domestic animals. And in Egypt, where the palm is of spontaneous growth, dates, besides being the chief sustenance of the people, are so plentiful, that, from a very early period, they have been



THE PALMYRA PALM.

commonly given to camels. When first introduced into this country, they could only be bought by the wealthy and luxurious, being sold as high as 6s. or 7s. per lb.; but now the imports of them have so much increased that the price is only as many pence as it was formerly shillings; the dried fruit, however, gives us little idea of it in its fresh state, when it is soft and pulpy, and calculated to allay thirst as well as hunger.

The Date Palm sometimes grows as high as eighty feet; it comes into bearing at from the sixth to the tenth year, and remains productive for a hundred years or more—some authorities say two hundred. A hundred full grown trees will yield about forty hundred weight of dates in a year; they are a source of great profit to the proprietors, and of revenue to the government of northern Africa, where taxation is levied on about 2,000,000 of these trees. The Tafilat Dates are considered the best. The Arabs, and other people of Africa pound and knead the fruit into solid black cakes for the use of the caravans on their desert journeys; these are extremely hard, but softened and mixed with water, they afford a pleasant and nutritious food. The stones, too, when steeped in water, are given to cattle, in the sterile districts where no grass is to be had; and it is said, that, after being burned, the Chinese use them in the preparation of Indian ink. Of the leaves, hats, mats, and baskets are made, and the fibres of the footstalks supply cordage, ropes, and sails for boats; the long footstalks were formerly used as javelins, and at the present day they supply fuel. Of the wood of the trunk, which is hard and durable, houses are constructed, and thatched with the leaves, while of the sap, a beverage called palm wine is made. It is generally supposed to have been with the leaves of this kind of palm that the multitudes strewed the way on Christ's entry into Jerusalem; hence, in Italy, and other catholic countries, where the fruit does not ripen, it has been extensively cultivated for use in the religious ceremonies of Palm Sunday. The Jews also use palm branches at the celebration of their feast of the Passover. Throughout India we find the wild date (*P. Sylvestris*), which was supposed to be the normal form of the cultivated species almost universal; it goes by the several names of *Kujjoor*, *Hinda*, or *Linda*, and *Caden*, in different districts; it does not yield fruit, but a large quantity of juice or palm wine, from which, in Bengal, sugar is made. On the coast and hills, where the soil is sandy, from the Ganges to Cape Coroman is found the Farinaceous Palm (*P. Farinafera*), called by the Telingas *Chetia-cita:* the trunk is seldom more than two feet high; it abounds in a coarse kind of farina, which the natives eat in times of scarcity.

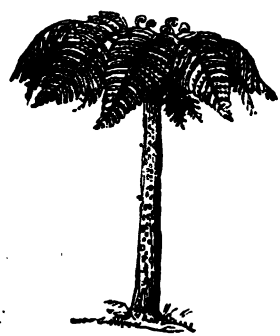
Palm wine, of which we have several times spoken, is, when fresh, a delicious beverage; it is obtained from various species of palm, by crushing the young inflorescence, and cutting off the upper part. The juice which flows out is collected in a vessel attached to the cut end. *Toddy*, or *toree*, is the name given to the fresh sap; and the sugar which it yields in evaporation is termed *joggery*. Several kinds yield this juice, but especially the cocoa-nut palm (*Cocoa Nucifera*), the Gorunto palm (*Saguerous Saccharifer*), and the magnificent Palmyra palm (see cut) termed by botanists *Borassus Flabelliformis*, which is, perhaps, the most widely distributed of all this tribe of plants. The cut exhibits it in different stages of growth, in one of which the pointed lines down the trunk give it the appearance of being armed with stout spines. Sometimes the date palm assumes this foliated character down the stem. Although there the leaves do not stand out so sharply, but rather fall around the central column in a more graceful manner. The beauty of the Palmyra has been the theme of all travellers in tropical countries. Livingstone speaks of it in tones of high admiration, rising above the other trees of the river bank, with its feathery foliage standing out sharply from the background of bright blue sky.

The tree which produces the palm oil of Africa, which has lately come very much into use in English manufactories, is the *Elæis* of botanists; it is found throughout the whole of the east coast of central Africa, and has been introduced into the West Indies and South America. The natives call this oil *ghee*, or butter, and use it as such in its native liquid state. Of the oil obtained from the nuts they make soap. There is no such good anti-attrition known as palm oil, and little else is now used for the wheels of railway carriages; it is also largely employed in the manufacture of candles and soap.

The Cocoa Nut Palm is one of nature's richest gifts to man; every part of it is adapted to human necessities, and without it the islands of the Pacific would be uninhabitable; the juice, the fruit, the oil, the pith, the sap, the fibre; the leaves, which are from fifteen to eighteen feet long, and the wood, all minister to man's necessities, and we lack space, even to enumerate the many different uses to which they are put. Then we have the palms of the genus *Sagus*, celebrated for their nutritious farina, known in commerce as *sago*, this is obtained from various species of the above genus, the chief being *S. Rumphii*, *S. Lævis*, and *S. Farinafera;* which are found in the Indian Archipelago. The Cabbage

Palm (*Areca Oleracea*) is found chiefly in the West Indies; it grows from 170 to 200 feet high, and has a trunk seven feet in circumference, and leaves twenty feet long, which are used by the negroes as cradles for their children. The terminal bud, which is the cabbage, is said to taste like almond, only sweeter; it is eaten with meat as a vegetable; it is, however, a luxurious and extravagant dish, as the removal of the bud involves the destruction of the tree whose every part is of the utmost utility.

We might speak of many other kinds of palms did our space permit, for there are no less than 200 species of these princes of the vegetable world; but it is desirable that we should say a few words, in conclusion, on the religious associations of the tree, which, in catholic countries especially, is held to be sacred. In these countries, it is customary on *Palm* or *Passion Sunday*, which is the first Sunday before Easter, to carry palm branches to the churches, and to strew the way by which the procession of the Host passes therewith. The palm-flowers, leaves, and boughs are laid upon the high altar, and over them is solemnized a rite of consecration, after which certain of them are preserved to be burned for holy ashes to lay on the heads of the people on Ash-Wednesday. In this country we have no native palms, but the name is given by the country children to the flowing branches of the Grey Willow, or Sallow (*Salis Cinerea*), which they gather on Palm Sunday in memory of the ancient custom; and up to quite a recent date, these slips of the willow, with their velvety-looking buds, were stuck in some English churches at Easter.



THE PEONS.

In crossing some of the highest chains of mountains in the northern states of South America, the traveller depends on the services of a race of men called Peons, or Bearers, who serve at the same time to perform the office of mules, porters, and carriages. The traveller, in fact, rides upon the back of one of these Peons, seated in a rough kind of chair, which is strapped to his shoulders, and round his waist, while other Peons carry his baggage, bedding, and provisions. The road from station to station, is a mere tract through dense forests, over muddy streams, along the beds of torrents, and the height to which it ascends

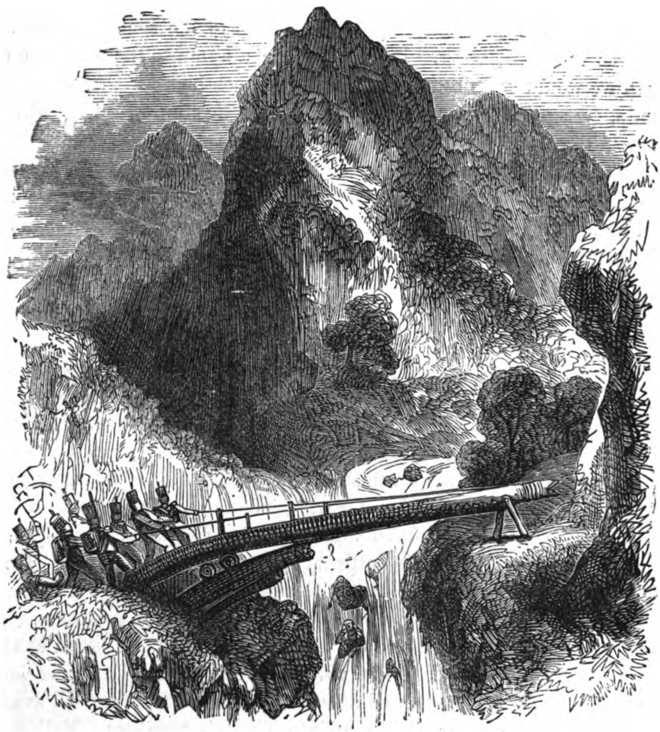
amounts often to 11,000 feet. In descending the mountains, the Peon walks backwards; often by such steep paths as to be obliged to cling to the ferns and twigs within reach, to save himself and his rider from falling down the most fearful precipices. All this time the rider sits with his knees up to his chin, and endures the most overwhelming fatigue, while his bearer plods on with inexhaustible energy and strength from morning till night, only occasionally depositing his load upon a dry piece of rock while he rests to take breath. The character of the Peons is, however, more remarkable than their physical strength. Cheerful, obliging, and uncomplaining, the most terrible fatigue seems never to depress their spirits or diminish their mental energy. The safety and comfort of a large party of helpless English travellers will depend upon their dexterity and promptitude, and never find them wanting in resources, even in the most desperate emergencies. On arriving at a station they cook the dinners of the whole party, and prepare the next morning's breakfast; and when camping for the night, the Peons construct tents to receive the beds of each of the party, and for these tents or temporary huts, large palm leaves are carried on the back of one of the Peons to form a kind of thatch. These leaves, strung on strings and stretched between poles, form a very sufficient protection from the heaviest dews and rain. Sometimes, on reaching a little village or town, in which a fête is being celebrated, when the tired traveller goes to his bed or hammock, the Peons will join in the dance, of which they are passionately fond, and dance the whole night through.

A recent English traveller gives the following testimony to the remarkable honesty of the Peons :—"The more one hears about these uncultivated men, the more one admires the probity and good conduct which distinguishes them. They are so trustworthy in the charge they undertake that one might confide a bag of uncounted gold to their care with every security that it would be restored as it left the hands of its owner. One trait that we heard of their conduct towards each other is highly interesting. These men when they leave home provide their own rations both for going and returning, the half of which they bury in the ground at different points in their route, and though these hiding-places are known to all, yet so sacred do they consider the property of each other, that nothing but the greatest necessity would induce them to touch it. A short time ago some of these men were out longer than they expected, and provisions failing, there was no alternative but to attack the stores of the others. But upon a leaf, in a very tolerable hand, one wrote—'Friend, hunger has compelled me to take some of your rations. I only trust that such necessity may never be your lot, but I will honestly pay you what I have taken on my return.'" The traveller's journal goes on to say—"These Peons are full of consideration for us, and anxious to do everything to smooth away our difficulties. To-day we have been obliged to cross the river no less than four times, and it is so swelled that the passage is very difficult and perilous, the Peons being obliged to wade through it, entering in when in profuse perspiration and the waters freezingly cold. When nearly at the top of the mountain, my Peon stopped to drink, and in answer to my enquiry as to where water could be obtained at such a height, he pointed to some large leaves which, doubled up, formed a sort of natural cistern which had collected the rain water. In halting for the night, and after we had retired to rest, we were startled by a curious kind of chorus or chant, which was begun by the whole body of Peons. It was monotonous and tuneless; but the ear became soon accustomed to the sound, so that its effect was almost pleasing. It proved to be a hymn to the Virgin, and though we would have been glad that these men had a higher object of worship, yet we respected and admired the feeling of piety which prompted the song."

In the high characters of this race of men we are reminded of the good and simple natures of the ancient Peruvians, before they were contaminated by the conquering Spaniard. It may be that they are descendants of the postmen or carriers who were so much employed in the old kingdom of Peru.

A TRIUMPH OF ENERGY.

After the accession of Tippoo Saib to the throne of Mysore in 1782, the English made overtures for a termination of the war which had been commenced by his father, but, flushed by the possession of a large army, a well-filled treasury, a passion for war, and an inordinate sense of his own importance, Tippoo refused all terms of pacification, and left the English no alternative but to battle against him as they could. Lord Macartney, who was at that time the Governor of Madras, on becoming acquainted with the determination of Tippoo, resolved to prosecute hostilities with the greatest vigour, and having placed Col. Fullerton at the head of his force, he provided him with an army, collected from various parts, of 16,000 good troops, and afforded that excellent officer all available assistance in carrying the war into Tippoo's territory. Fullerton laid his plans with considerable skill; he encouraged the natives to bring and sell provisions to him on his march, effectually checked devastation and plundering, scrupulously inspected the religious opinions of the Hindus, consolidated and improved the mode of march, and availed himself of the subtle cunning and nimble feet of the natives to establish a remarkably complete courier-system, where he could receive and communicate intelligence with a rapidity never before attained by any European officer in India. He had to choose between two systems of strategy—either to march through the Mysore territory, and frustrate Tippoo in his siege of Mangalore; or boldly to attack Seringapatam, in order to compel Tippoo to leave Mangalore as a means of defending his



own capital. The colonel decided on the adoption of the latter course, as promising more fruitful results. Being at Daraporam, 200 miles south of Seringapatam, Fullerton resolved to divert the route, and take a circuit nearer the western coast, where the capture of the strong fort of Palagatcherry would afford him a valuable intermediate depot, commanding one of the chief roads from the Malabar to the Coromandel coasts. On the

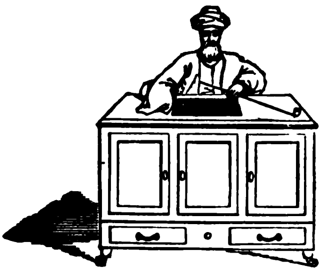
18th of October he started. After capturing a few small forts, he ascended to high ground, where dense forests, deep ravines, and tortuous water courses embarrassed every yard of his progress: to fill up the ravines before he could drag his artillery over them, to throw trees across them where the depth was too great for filling up, to clear gaps through forests with the axe, to contend against tremendous rains—were only part of the difficulties he had to meet; but he met them like a skilful commander, reached Palagatcherry on the 5th of November, and captured the fort on the 15th, obtaining with it a welcome supply of money, grain, guns, powder, shot, and military stores. When the difficulties which Colonel Fullerton had to encounter, and the triumphant manner in which he overcame them, are taken into consideration, it will be readily admitted, we think, that his enterprise is well deserving of being recorded as a striking example of what may be accomplished by a union of professional skill and invincible energy. Our engraving represents one of the devices which Colonel Fullerton employed for the purpose of enabling his forces to pass over a mountain torrent.

AUTOMATA.

I WILL tell you of a wonderful exhibition of Automata, which was to be seen in London not many years ago. It consisted of a number of images so beautifully and cleverly made, that they moved about,

played, ran, jumped, rode on horseback, and performed all sorts of feats and antics, quite as well, if not better, than real persons or animals could possibly do.

One of the most famous of these performers was that of the chess-player. This was a figure dressed like a Turk seated upon a cushion, who played at chess so well that he won games with some of the best chess players in London. When the person playing made a "false move," that is, did anything contrary to the rules of chess, he would shake his head and rap the board spiritedly with his hands. When he had the king in his power he called "*échec!*" which is the French word for check.

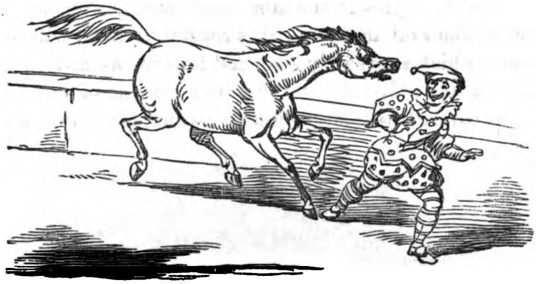


A French game, called the *carrousel*, was very pretty. This consisted of a number of figures on horseback riding round a circus with a fountain in the centre. These riders performed many wonderful feats.

One of them, a Spanish lancer, while at full gallop, caught a cap on the point of his lance.

Another of these galloping riders, armed with a tiny pistol, fired at a bird and killed it, while a third performed regular horse-riding feats, jumping over high standards and coming down again upon his feet on the horse's back.

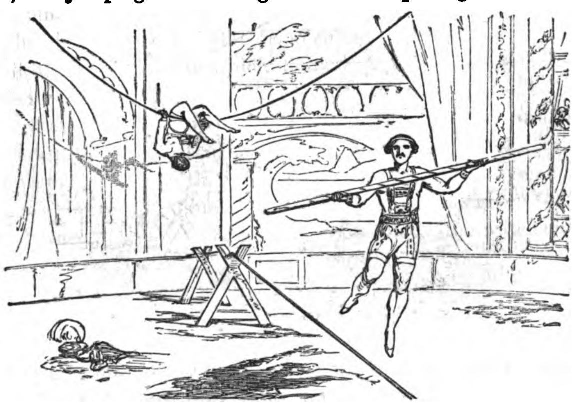
The performance of the horse and clown was very laughable. The clown, who was slow and very awkward, was pursued by a hungry horse with widely opened mouth; clown was soon overtaken, when the horse snapped off—his cap. Harlequin then came to poor clown's rescue, but



his horse kicked and reared so that he was soon thrown off, but in such a droll manner as made the children laugh famously.

One very pretty performance was that of the little wreath dancer—a beautiful figure, with wreaths of flowers all about her, dancing on the back of a horse, while it was galloping round the circus.

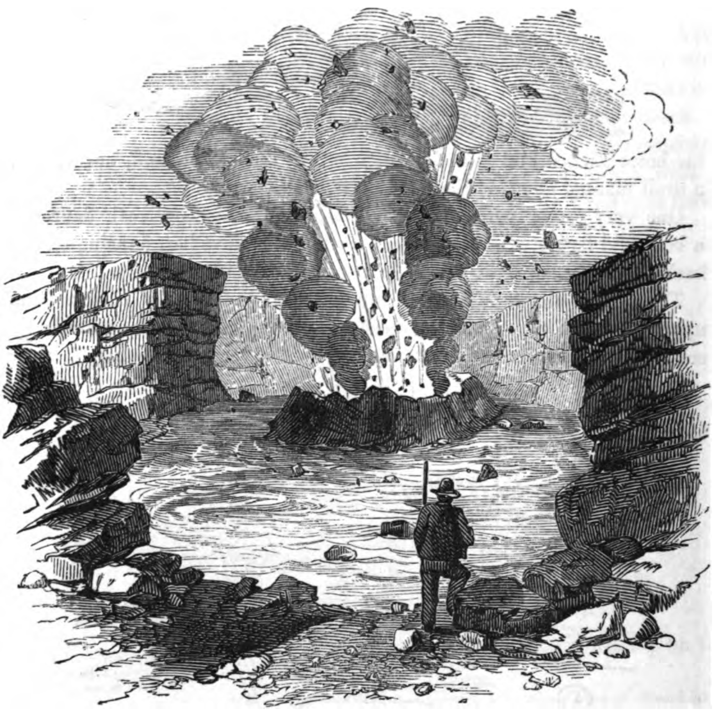
There were also rope dancers who performed all sorts of curious feats upon the slack rope; turning head over heels, hanging downwards by one foot, and jumping and dancing in a most surprising manner.



If this clever and interesting exhibition ever comes to London again we hope many of our young readers will be able to see it.

CRATER OF VESUVIUS IN 1829.

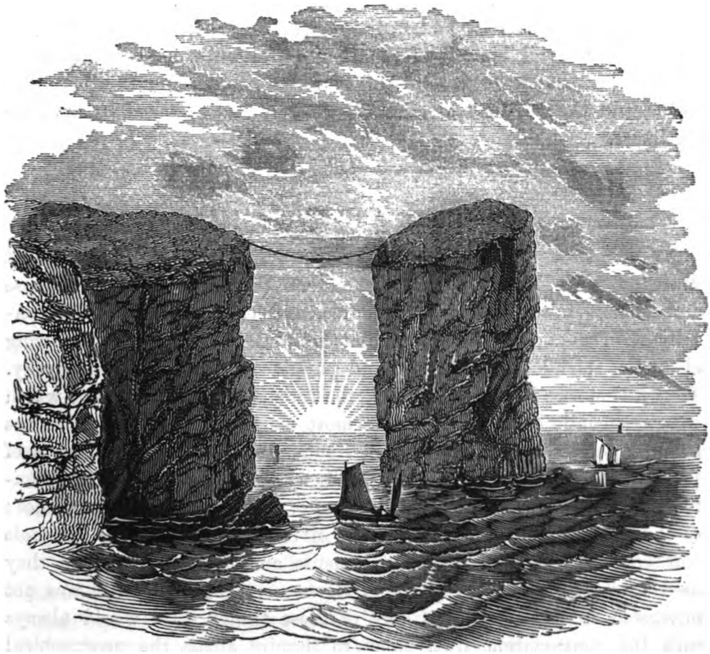
THE crater Stromboli, which has been in activity since the most ancient times, presents at present the same appearances as those which were described by Spallanzani in 1788. It is constantly filled with lava in a state of fusion, which alternately rises and falls in the cavity. Having ascended to ten or twelve yards below the summit of the walls, this boiling fluid is covered with large bubbles, which burst with noise, let-



ting enormous quantities of gas escape from them, and projecting from all sides scoriaceous matter. After these explosions it again subsides, but only to rise again and produce like effects—these alternations being repeated regularly at intervals of some minutes. In craters where the lava is less fluid than that of Stromboli, new cones are sometimes formed in the midst of the crater, which first rise in the form of a dome, and then burst out, so as to form a small active volcano in the middle of the great one. This phenemenon is often presented within the crater of Vesuvius, and was more particularly witnessed in 1829.

CRADLE OF NOSS.

Off Bressay is the most remarkable of the rock phenomena of Shetland, the Noss, a small high island, with a flat summit, girt on all sides



by perpendicular walls of rock. It is only 500 feet in length, and 170 broad, and rises abruptly from the sea to the height of 160 feet. The communication with the coast of Bressay is maintained by strong ropes stretched across, along which a cradle or wooden chair is run, in which the passenger is seated. It is of a size sufficient for conveying across a man and a sheep at a time. The purpose of this strange contrivance is to give the tenant the benefit of putting a few sheep upon the Holm, the top of which is level, and affords good pasture. The animals are transported in the cradle, one at a time, a shepherd holding them upon his knees in crossing.

The temptation of getting access to the numberless eggs and young of the sea-fowl which whiten the surface of the Holm, joined to the promised reward of a cow, induced a hardy and adventurous fowler, about two centuries ago, to scale the cliff of the Holm, and establish a connection by ropes with the neighbouring main island. Having driven two stakes into the rock and fastened his ropes, the desperate man was entreated to avail himself of the communication thus established in returning across the gulf. But this he refused to do, and in attempting to descend the way he had climbed, he fell, and perished by his foolhardiness.

ALEXANDER AND BUCEPHALUS.

At one time some ambassadors from the Persian court arrived at Macedon while King Philip (Alexander's father) was away. These ambassadors saw Alexander, of course, and had opportunities to converse with him. They expected that he would be interested in hearing about the splendours and pomp and parade of the Persian monarchy. They had stories to tell him about the famous hanging-gardens, which were artificially constructed in the most magnificent manner on arches raised high in the air; and about a vine made of gold, with all sorts of precious stones upon it instead of fruit, which was wrought as an ornament over the throne on which the King of Persia often gave audience; of the splendid palaces and vast cities of the Persians, and the banquets and fêtes and magnificent entertainments and celebrations which they used to have there. They found, however, that Alexander was not interested in knowing about any of these things. He would always turn the conversation from them to inquire about the geographical position of the different Persian countries, the various routes leading into the interior, the organization of the Asiatic armies, the system of military tactics, and especially the character and habits of Artaxerxes, the Persian king.

The ambassadors were very much surprised at such evidences of maturity of mind, and far-seeing and reflective powers on the part of the young prince. They could not help comparing him with Artaxerxes. 'Alexander,' said they, 'is *great*, while our king is only rich.' The truth of the judgment which these ambassadors thus formed in respect of the qualities of the young Macedonian, compared with those held in high estimation on the Asiatic side, was fully confirmed in the subsequent stages of Alexander's career.

In fact, the combination of a calm and calculating thoughtfulness, with the ardour and energy which formed the basis of his character, was one great secret in Alexander's success. The story of Bucephalus, his famous horse, illustrates this in a very striking manner. This animal was a war-horse of very spirited character, which had been sent as a present to Philip while Alexander was young. They took the horse out into one of the parks connected with the palace, and the king, together with many of his courtiers, went out to view him. The horse pranced about in a very furious manner, and seemed entirely unmanageable. No one dared to mount him. Philip, instead of being gratified at the present, was rather disposed to be displeased that they had sent him an animal of so fiery and apparently vicious a nature that nobody dared to attempt to subdue him.

In the mean time, while all the other bystanders were joining in the general condemnation of the horse, Alexander stood quietly by, watching his motions and attentively studying his character. He perceived that a part of the difficulty was caused by the agitation which the horse experienced in so strange and new a scene, and that he appeared also to be somewhat frightened by his own shadow, which happened at that time to be thrown very strongly and distinctly upon the ground. He saw other indications, also, that the high excitement which the horse felt was not viciousness, but the excess of noble and generous impulse.

Philip had decided that the horse was useless, and had given orders to have him sent back to Thessaly, whence he came. Alexander was very much concerned at the prospect of losing so fine an animal. He begged his father to allow him to make the experiment of mounting him. Philip at first refused, thinking it very presumptuous for such a youth to attempt to subdue an animal so vicious that all his experienced horsemen and grooms condemned him; however, he at length consented. Alexander went up to the horse, and took hold of his bridle. He patted him on the neck, and soothed him with his voice, showing, at the same time, by his easy and unconcerned manner, that he was not in the least afraid of him. A spirited horse knows immediately when any one approaches him in a cautious and timid manner. He appears to look with contempt upon such a master, and to determine not to submit to him.

At any rate, Bucephalus was calmed and subdued by the presence of Alexander. He allowed himself to be caressed. Alexander turned his head in such a direction as to prevent him from seeing his shadow. He quietly and gently laid off a sort of cloak which he wore, and sprang upon the horse's back. Then, instead of attempting to restrain him, and worrying and checking him by useless efforts to hold him in, he gave the rein freely, and animated and encouraged him with his voice, so that the horse flew across the plain at the top of his speed; the king and courtiers looking on, at first with fear and trembling, but soon afterwards with feelings of the greatest admiration and pleasure. After the horse had satisfied himself with his run, it was easy to rein him in, and Alexander returned with safety to the king. The courtiers overwhelmed him with their praises and congratulations.

Alexander's judgment of the true character of the horse proved to be correct. He became very tractable and docile, yielding a ready submission to his master in everything. He would kneel upon his forelegs at Alexander's command in order that he might mount more easily. Alexander retained him for a long time, and he became his favourite war-horse. A great many stories are related by the historians of those days of his sagacity and his feats of war. Whenever he was equipped for the field with his military trappings, he seemed to be highly elated with pride and pleasure, and at such times he would not allow any one but Alexander to mount him.

What became of him at last is not certainly known. There are two accounts of his end. One is, that on a certain occasion Alexander got carried too far into the midst of his enemies on a battle-field, and that after his fighting desperately for some time, Bucephalus made the most extreme exertions to carry him away. The horse was severely wounded again and again, and though his strength was nearly gone, he would not stop, but pressed forward till he had carried his master to a place of safety, and that then he dropped down exhausted, and died. It may be, however, that he did not actually die at this time, but slowly recovered;

for some historians relate that he lived to be thirty years old, which is quite an old age for a horse, and that he then died. Alexander caused

to be buried with great ceremony, and built a small city upon the spot in honour of his memory. The name of the city was Bucephalia.

THE INDIAN AND HIS DOG.

In America, a long way off, near the Blue Mountains, and far away from any town, lived a man who had eleven children. One day the

youngest could not be found; he was four years old, and had not been seen after ten o'clock. He was looked for everywhere round the house and fields, but in vain. Sad and fearful it was; the neighbours were called, to help and search through the woods on every side. Night came, and the child was not found. The neighbours went home, but the parents did not. They thought of the wild mountain cats, and other creatures that might find and hurt their boy. "Derrick! my poor little Derrick! where are you?" said the mother, and her tears fell fast. When daylight came, they were helped again by all their friends; but, sad as before, they at last went back. That day, however, an Indian, with a load of firs, came from a place far off, and stopped at the farm-house to rest. No one was in the house but a black woman, too old and too feeble to go out. "Where is my friend?" said the Indian. "He has lost his little Derrick, and is gone with all the neighbours to seek him in the woods." It was then three o'clock in the afternoon. "Blow the horn," said the Indian, and "call thy master home; I will find his child." The horn was heard, and as soon as the father came back, the Indian asked for the shoes and stockings that little Derrick had worn last. Then he spoke to his dog, and bade him smell them as he held them out. The dog and man went out to walk round the house, and the dog put his nose close to the ground all the way, and soon began to bark. This made the poor people feel some hope. The dog went on and barked again, and set off so fast no one could follow him; and he, too, was lost sight of in the woods. After a while the bark was heard again. And back came the dog, looking so glad, and went up to his master, as if sure he had done his bidding. "He has found the child," said the Indian. The dog could not speak and say if he were dead or alive; but any one who knew the ways of a good dog would feel almost sure that such gladness meant, "All is well." The Indian then went after his dog a great way, till they came to the foot of a large tree, where lay the boy, too weak to get up or know what had come to help him. The Indian carried him home as fast as he could; and we may believe how thankful the parents were, though they could not say so for a long time. The Indian was glad also, and helped them to take care of the child until he got better and was able to eat, and by degrees to tell how he had strayed, and fell down, and remembered no more. But the dog seemed to know all about it: and, at last, he and his master were rested, and obliged to say "good-bye," to those they had served so well, and who never forgot the kind Indian and his sagacious dog.

SNAKE CHARMERS.

In the East Indies, the Pambatees, or snake-charmers, come from the mountains called the Ghauts. They make a trade of catching serpents, training them, and exhibiting them for money. These reptiles are commonly the *cobra-di-capello*, the hooded or spectacle serpent, and of other similar species. A Pambatee will sometimes carry eight or more of them in a low round basket, in which the serpents lie coiled round one another.

As soon as the lid is removed from the basket, the serpent creeps out of it. The master plays on an instrument somewhat resembling the bagpipe, and the snakes are taught to mark the cadence by the motion of their heads, till at length they fall asleep. In order to rouse them, the Pambatee suspends his music and shakes a ring round his arm to which a piece of red cloth is fastened. The irritated serpent darts at the ring; but as the master has taken care to extract the pouch containing the poison, and to file his teeth, he can do no harm.

The musical instrument just mentioned is called *magootee*. It is composed of a hollow calebash, to one end of which is fitted a mouth-piece similar to that of the clarinet. To the other extremity is adapted a tube perforated with several holes, which are successively stopped by the fingers, like those of the flute, while the player blows into the mouth-piece. In the middle of the instrument is a small mirror, on which the serpents fix their eyes while dancing. The engraving will convey a correct idea of the Pambatee and his instrument.

Some animals are held in universal dread by others, aud not the least terrible is the effect produced by the rattle-snake. Mr. Pennant says, that this snake will frequently lie at the bottom of a tree on which a squirrel is seated. He fixes his eyes on the animal, and from that moment it cannot escape; it begins a doleful outcry, which is so well known that a passer-by, on hearing it, immediately knows that a snake is present. The squirrel runs up the tree a little way, comes down again, then goes up and afterwards comes still lower. The snake continues at the bottom of the tree, with his eyes fixed on the squirrel, and his attention is so entirely taken up, that a person accidentally approaching may make a considerable noise, without so much as the snake's turning about. The squirrel comes lower, and, at last, leaps down to the snake, whose mouth is already distended for its reception. Le Vaillant confirms this fascinating terror by a scene he witnessed. He saw on the branch of a tree a species of shrike trembling as if in convulsions, and at the distance of nearly four feet, on another branch, a large species of snake, that was lying with outstretched neck and fiery eyes, gazing steadily at the poor animal. The agony of the bird was so great that it was deprived of the power of moving away, and when one of the party killed the snake, it

was found dead upon the spot—and that entirely from fear—for, on examination, it appeared not to have received the slightest wound. The same traveller adds, that a short time afterwards he observed a small mouse in similar agonizing convulsions, about two yards from a snake, whose eyes where intently fixed upon it; and on frightening away the reptile, and taking up the mouse, it expired in his hand.

WILD ANIMALS:

THEIR HOMES, HAUNTS, AND HISTORIES.

THE LION.

It is in Africa, and especially in South Africa, that animal life appears to have reached its maximum, both as regards size and numbers. All travellers in that part of the world agree in stating that the abundance of wild creatures, and especially those of the larger kind, is perfectly astonishing; and the testimony of Dr. Livingston is, as we have several times had occasion to notice, to the same effect. When we read of 900 elephants being killed on one river alone in three years, and this for the sake of their tusks, what an idea does it give us of the amazing numbers of these huge mountains of flesh which must inhabit the almost impenetrable forests and wild wide mountain ranges of torrid Africa! Gordon Cumming, that mightiest of modern hunters, thinks little of bagging his four or five bull-elephants in a day, not to speak of hippopotami and rhinoceri, buffaloes, giraffes, and such small make-weights. He sees the first-named of these huge creatures, congregating in vast herds, sometimes a hundred or more together; he rides in, and singles out his bull, and sometimes with three or four lucky shots, but oftener with twenty or thirty, brings him down, after an obstinate fight of some hours, during which the hunter incurs great danger from the tusks, and trunk, and enormous limbs of the infuriated animal, which rushes with shrill trumpeting upon its assailant. This one despatched, he follows in the wake of the retreating herd, selects another, disables it perhaps, and leaves it to be finished by his after-riders, or other attendants; while he, still eager for more ivory, again overtakes, again slays, and goes on until night and darkness put an end to his exciting sport, or his wearied limbs absolutely refuse to bear him any further. His best horses are worn out with fatigue, or otherwise disabled—and he must rest; and rest he does—amid the trumpeting and snorting, yelling and roaring, of the wild dwellers in the desert, and forest, and the reedy swamp. Sometimes a lion with shaggy mane, and fiery, flashing eyes, looks in upon him as he sits by the fire within his fence of wait-a-bit thorn, seeking for a meal of horse-flesh, or ox-flesh, or man-flesh, whichever comes handiest. The Hottentots are frightened out of their senses at the approach of their dreaded enemy "Tao;" but our hunter is calm and collected, while his stanch dogs, let loose, do battle with the intruder, which presently, perchance, receives a shot that makes him bound off, yelling and roaring, in pain and anger. Sometimes it is ride for your life, with the horn of an infuriated rhinoceros close to your horse's flanks, rushing and crashing, amid rocks and trees, and thorny bushes, and dry water-courses, with many a trip and stumble, and, it may be, a downfall altogether, and a miraculous escape sideways, or other ways, from the snorting pursuer, which plunges on, carrying off some ounces of lead in his leathery hide; or by-and-bye tumbles prone, and yields up his horn to the hunter, and his flesh to the hungry natives. Sometimes it is watching from a reedy covert the gambols of a school of hippopotami, taking their morning bath in the waters of the Limpopo, or some other river with an equally euphonious title. Bulls, and cows, and calves, are there, all intent on taking their fill of enjoyment; plunging and wallowing, splashing and snorting, now popping up their monstrous heads above the stream, now disappearing altogether beneath it, and again emerging like so many islands of dark grey mud, just come to the surface. The finest bull is selected, the ball crashes through the bony plate which protects the brain, and the agonised creature makes a whirlpool amid the waters, dives to the bottom, remains there awhile, rises again to receive another shot, dives again, but finally floats a dead carcase of immense size and repulsive aspect, to be hooked and bound with thongs of buffalo-hide, as it strands on the gravelly bank, and drawn up high and dry, to have its huge head severed from its body as a hunter's trophy, and its flesh carried off as food to the Bushman's hut, or the Bechuana village, or the kraal of some other of the scattered or wandering tribes. Should it be left till night, the lions and jackals, panthers or hyænas, will feast on it; or if it remains in or near the water, the scaly crocodile will leave his basking in the mud to come and enjoy the savoury food; while in either case, stooping from above, the broad-winged and keen-scented vultures will take their share of the feast.

Sometimes it is away over the desert, with the speed of light, pursuing the solitary ostrich, or the troop of zebras or quaggas, graceful and beautiful in their every aspect and motion; or the bounding antelopes, the pallahs, the khodoos, the hartebeests, the springboks, and the blauboks, the rough-mained gnus spurning the sand with their cloven feet. Chasing the wild boar among the hills, the buffalo in the reedy *vley*, or marsh; the bush-buck on the river banks, or the little klipspringer, smallest and nimblest of antelopes, amid the rocks; watching the tall and stately giraffe, as it bends down with its curled tongue the lithe boughs of the lofty trees, on whose tender shoots it loves to feed; or drawing the rock-snake from its hiding-place; sending the clamorous wild dogs flying with a shout or a shot, and scaring the jackal and hyæna from their repast on the carcass, which has already afforded a meal to their king—the majestic lion.

But we will now proceed to speak more particularly of the wild animals of South Africa, premising that our account must be of the briefest description, having to crowd into a single chapter a whole menagerie of beasts, a full account of the habits and characteristics of which would fill a goodly volume. And first for the lion, the majestic brute whose sovereignty no animal dares to dispute.

Some of our boys no doubt remember Ferdinand Freiligrath's graphic description of "the lion's ride" on the back of the giraffe, where he had sprung from his hiding-place in the reeds, when the stately creature came to drink. What a ride was that over a blood-besprinkled track—with panting, heaving chest, glazed and filmy eyes, and every nerve quivering with terror and agony, the maddened steed flew on, his royal rider feasting as he went on this triumphal progress over his wide domain. No pause, no rest, while life and strength remained—on! on! with a wild and terrible cry, like the shriek of despair, over the rocky ridge, over the sandy waste, miles and miles away from the green pastures and pleasant woods, from kindred companionship, and the sound of running water. Flecked with foam, bedabbled with gore, is the smooth shining skin; there is fire in every vein, a burning and consuming thirst, a weariness and exhaustion of strength that would prostrate every energy, were it not for the sharp stimulus of rending talons and fangs piercing into the very vitals. Still for awhile he staggers on, with unsteady gait and relaxed speed, and now a sharper pang shoots through his frame, and gives a momentary impulse to his mad career; but alas! as Pringle tells us in his spirited lines,—

"'Tis vain! the thirsty sands are drinking
His streaming blood—his strength is sinking:
The victor's fangs are in his veins;
His flanks are streaked with sanguine stains:
His panting breath in foam and gore
Is bathed: he reels: his race is o'er."

And now, leaving his bones to whiten in the desert, after they have been picked clean by the hyænas, jackals, and vultures, let us confine our attention for awhile to his destroyer;—

"Would'st thou view the lion's den?
Search afar from haunts of men—
Where the reed-encircled rill
Oozes from the rocky hill,
By its verdure far descried
'Mid the desert brown and wide,"

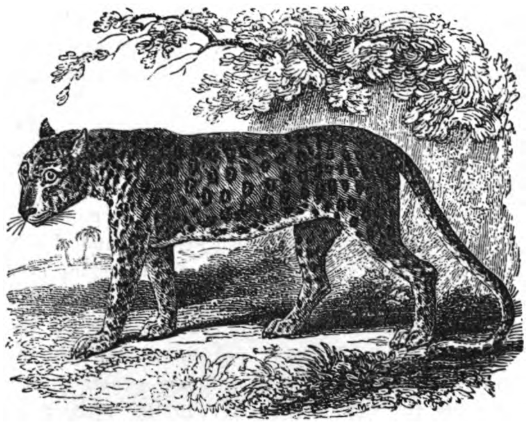
says, Pringle, who thus, in a few lines, gives us a graphic picture of a favourite retreat of the lion of South Africa, where he, perhaps, attains a larger size, and a more perfect development of all his brute powers and faculties, than elsewhere. In such a spot as this, in his rocky hiding-place, to which he must often resort to satisfy the thirst to which all carnivorous animals are more subjected than those which feed on the juicy herbage, lurks the grim, and oftentimes gory desert-king. Seldom, unless impelled by great hunger, does he stir abroad until the shades of night begin to close around; and there, where the gloom is rendered yet deeper by the shadow of the overhanging rocks, or the interception of the little light that is left by the tall grass or reeds, his fiery eyes may be seen gleaming like live coals, ready for his prey.

PERSIAN LION.

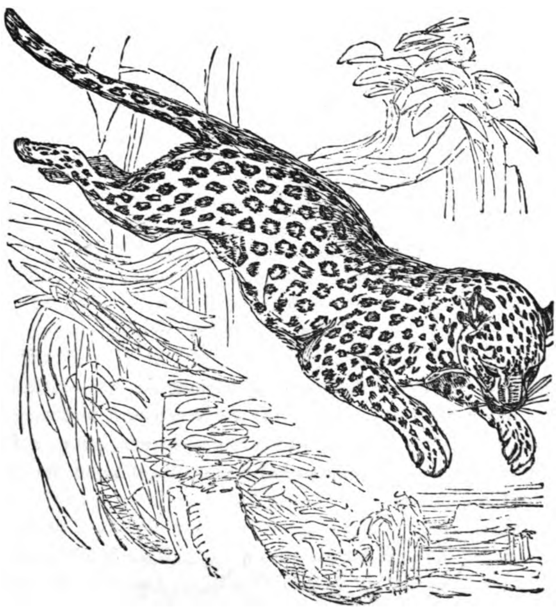
Of the Lion, which is the *Felis Leo* of naturalists, several varieties, or breeds, are known, but their points of difference are scarcely marked enough to be called specific; they were formerly much more widely diffused throughout the world than they are at present. Africa, some districts of Arabia, and Persia to the country bordering on the Euphrates, and some parts of India, are now their only habitats; for the Puma—*Felis concolor*, or *Leo Americana*, as some call it—is not properly a lion, but is more nearly allied to the Panther. Of the Asiatic breeds, the Bengal, and the Persian or Arabian lion, we need not here speak, nor of the maneless lion of Guzerat, recently discovered by Captain Smee. Of the African lions there are three kinds—the Barbary, distinguished by having a deep yellowish-brown fur, and full flowing mane; the Senegal, which is more of a yellow tint, with a smaller mane, which is nearly wanting on the breast and between the fore legs; and the Cape, which presents two varieties, one yellowish and the other brown, the mane deepening into black. This black-maned lion is called by the Dutch settlers *Schwart fore-life*, and is the most dreaded for its strength and ferocity. The yellow variety they call *Chiel fore-life*. Kaffirs, Bechuanas, and other South African tribes, have a great horror of "Tao," as they term him. Being without adequate means of defence, they are often victims to his murderous attacks. Having once tasted human flesh, he is said to prefer that to any other kind of food, and hence the proximity to the kraal of a "man-eater" fills the whole community with consternation. As a general rule, the lion will rather avoid coming in contact with man, beneath whose fixed glance it has been known to quail, and at the sound of whose voice it has often fled. Time out of mind it has been considered an emblem of strength and bravery. Strong it undoubtedly is, and when pressed by hunger, or infuriated by pain, or the baiting of dogs, or the attack of the hunter, it will, like any other wild creature, conscious of possessing the means of offence, disregard every danger, and fight desperately to the last. But for all that, we should not consider boldness and bravery as characteristic traits of the lion; it is well placed by naturalists at the head of the family *Felinæ*, being a true cat in its nature and habits; a skulking, stealthy brute, with padded feet that enable it to move noiselessly; its favourite attitude is crouching, ready for the spring, and it rarely meets its prey even face to face, unless obliged to do so. Cumming, as well as Gerard, frequently went close up to lions, and having the nerve to face them boldly, commonly did so with impunity. If the creature had a way open for escape, it would usually avail itself thereof—that is, before it received its first wound; after that, how to destroy its enemy would be its great object and desire. With a port and presence calculated to overawe the fiercest of its fellow roamers of the wilderness, and to shake the stoutest nerves—mighty, and majestic, and terrible as it undoubtedly is—we yet see that it is often met and bearded by puny man! Its brute strength is no match for his mental power; and although this king of the desert may, for a time, dispute man's claim to the sovereignty of the whole earth—may for a time roam unmolested over those arid tracts which are unfit for cultivation, or lurk unseen in the depths of the pathless forests, yet it must eventually be driven out even from these places of refuge, and become extinct. In many parts of the world, where it was once plentiful, it is now extremely rare, if it be not altogether absent. Before the advancing footsteps of civilisation, it retires further and further into the most dreary and inaccessible wilds.

It is in Africa, no doubt, that the lion will longest retain his place of dominion—this is his more especial realm. Here he finds the most inaccessible retreats—here is food most plentiful; antelopes of various species and other wild creatures roam the sandy plains, and haunt the rocky ravines and grey gloomy forests in countless numbers; and he has only to pick and choose of the best and tenderest. He is something of an epicure in his feeding when not much presssed by hunger, and will take only certain parts of the animal he has slain; he generally takes his meals early in the morning or late in the evening, and slumbers during the heat of the day; then is the best time for attacking him, for he is dull and heavy, not easily aroused. The wild Bushmen, who flee from him at other times, take this opportunity of approaching his lair, and shooting him with poisoned arrows, which, though they may fail to arouse him at the time the wound is inflicted, generally prove fatal in the end. Happily the lion is not a very prolific breeder, nor does it quickly attain maturity, five years being the period which elapses before it reaches its full strength and stature. What that strength is, we may judge from the fact that one of these animals has been known to convey a horse about a mile from the spot where he killed it; and that another, which had seized a two-year old heifer, was followed for five hours by horsemen, who observed that, through the whole progress of the chase, the lion carried its burden without much apparent difficulty, only letting it once or twice touch the ground; what, then, must a man be in the jaws of such a creature? let the crushed bones and mangled form of poor Hendrick, Cumming's wagon-driver, answer the question. He was seized by a fierce man-eater while lying by the fire in the camp, surrounded by a strong hedge of wait-a-bit thorn, and safely guarded, as he thought, by the dogs and muskets of himself and companions, as well as by the glare of the burning brands—seized and carried off, as a mouse might be by a cat, and devoured within forty yards of the spot, while his master and terrified comrades sat listening to the growling of the horrid brute, without being able to attempt his rescue.

THE LEOPARD.



There are five other species of the *felinæ*, or cat family, found in South Africa; the largest and most formidable of these, next to the lion, is the Leopard. This animal is chiefly found in the mountainous districts, where he preys on such of the antelopes as he can surprise, on baboons, and on the *Das sie* of the colonists *(hyrax Capensis)*. He is much dreaded by the Cape farmers for his ravages among the flocks and the young fowls, and calves in the breeding season. Its habit, while watching for prey, is to crouch on the ground, with its fore-paws stretched out, and its head between them, with its eyes rather directed upwards. Extremely agile and graceful in all its movements, there is, perhaps, no animal more beautiful than this sleek and elegantly-formed cat; but one had better not approach too close in examination of its beauties. Although it will generally flee before the approach of man, yet instances are not wanting of its having attacked an intruder on its haunts with the greatest fury, and so severely lacerating him as to cause death. Among some of the natives of the western coast this animal is considered sacred, and never hunted, although it occasionally approaches the villages and destroys children, and even women. The Cape colonists,

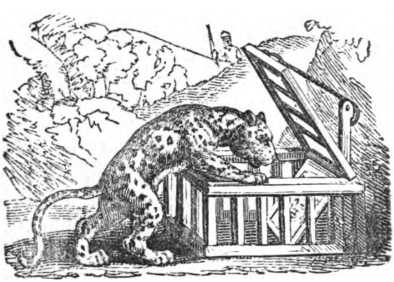


LEOPARD OF SENEGAL.

however, have no such respect for the animal; and its low, half-smothered growl, heard at night in the neighbourhood of the cattle kraal, is the signal for a general turn-out for its destruction. When hunted, it generally takes to a tree, if one is within reach, and can only be dislodged from thence by a musket-ball. It is often caught in a trap and baited with dogs, two or three of which it generally kills before it is overpowered. Mr. Orpen, Cumming's companion in his last campa had an encounter with a male leopard, which had nearly proved fatal to him. The creature had been wounded, and sprung upon his assailant's shoulders, and, dashing him to the ground, lay on him, growling and lacerating his hands, arms, and head most fearfully; luckily its strength failed from loss of blood, and it rolled over, permitting Orpen to rise and get away. The native attendants, all this while, were afraid to come near enough to render any assistance; and had not the creature been struck in some vital spot, no doubt it would have killed the man.

"And the beautiful cat, with skin so sleek,
That looketh so mild, and seemeth so meek;
That leapeth down with an agile grace,
'Mid the clefts of its rocky dwelling-place;
That croucheth amid the waving grass,
With a wary eye upon all who pass;
What hath it sheathed in that velvet paw?
What hid 'neath the skin of that silky jaw?
Not talons to tear? not fangs to rend?
Ah, Ah! approach not near my friend!
For the lovely creature that looks so mild,
Hath a nature treacherous and wild.
Have you yet to learn that a beautiful skin
Full oft hideth much that is vile within?

Leopards and tigers are destroyed by various devices—pitfalls, traps, the spear, and gun. The plan of the box-trap and looking-glass for taking leopards, tigers, &c., and which we illustrate below, a device to be found in ancient sculpture, according to Montfauçon, is said to be practised by the Chinese.



THE TIGER.

The Royal Tiger as it is often called to distinguish it from the smaller tiger-cats, is far more limited in its range than the lion. It is exclusively Asiatic. Hindustan may be considered as its head quarters, but it is common in the larger islands, as Sumatra, where it is a fearful scourge. It is said to occur in the south of China, and also in the deserts which separate China from Siberia, and as far as the banks of the Oby. It is found in Tonquin and Siam. The ancients regarded India and Hyrcania as nurseries of the tiger. Hyrcania was a province of the ancient Persian empire, at the south-eastern corner of the Caspian Sea; but its boundaries are not very determinate. Whether the tiger still inhabits this district is not very clear; there is no reason, however, to doubt the concurrent testimonies of the ancient writers.

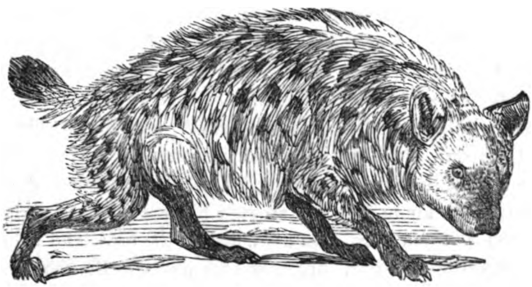
The tiger is equal in size to the lion, but of a more elongated form, and pre-eminently graceful. The head also is shorter and more rounded. Occasionally individuals occur exceeding any lion we have contemplated in menageries; but the average height is from three feet six inches to four feet. The general tint of the fur is of a fine yellow or reddish-yellow, ornamented by a series of transverse black bands or stripes, which occupy the sides of the head, neck, and body, and are continued on the tail in the form of rings: the under parts of the body and inner parts of the limbs are almost white. Individuals are sometimes exhibited of a very pale colour, with the stripes very obscure, and Du Halde says that the Chinese tiger (Lou-chu or Lau-hu) varies in colour, some being white, striped with black and gray.

The ancients make frequent mention of the tiger, with which it cannot be doubted that Aristotle was well acquainted, though he talks of a breed in India between this animal and the dog, meaning, perhaps, the cheetah, which is used for the chase. Pliny describes the "tremendous velocity" of the tiger, and the devoted attachment of the tigress to her young. Oppian speaks of swift tigers, the offspring of the zephyr; and of its swiftness Mr. Bell, the traveller, and Père Gerbillon, were witnesses in China, the chase of this animal being a favourite diversion with the great Cam-Hi, the Chinese monarch. It appears that Augustus was the first who exhibited a tiger at Rome, which was tame and kept in a cage. Claudius afterwards exhibited four, and Cuvier suggests that it was in commemoration of this rare spectacle, that the mosaic discovered some years since at Rome, was made representing four royal tigers in the act of devouring their prey. As, however, India and its products became better known to the Romans, the tiger became more familiar to them, but was never exhibited in greát numbers. Ten were in the possession of Gordian III.

Active, powerful, and ferocious, the tiger is more to be dreaded than the lion, because it is more insidious in its attack, and also prowls abroad by day as well as by night. In some districts of India, and in Sumatra, its ravages are frightful. We are informed by Colonel Sykes,

that, in the province of Kandeish alone, 1,032 tigers were killed from the year 1825 to 1829 inclusive, according to the official returns. In Sumatra, the infatuated natives seldom attempt their destruction, having a notion that they are animated by the souls of their ancestors. Tiger-hunting is one of the favourite field-sports of the East, and as the chase is not unattended with danger, it is productive of proportionate excitement. Though horsemen as well as persons on foot attend on these occasions, it is more for the sake of "being in at the death" than of taking a decided part, for the horse will seldom stand steadily when near this dreaded beast. It is to the armed riders on elephants that the dangerous work of rousing up the tiger from the jungle covert is left, and of firing at him as he bounds along. The tiger's first object is to escape under the covert of the long grass or jungle; but, when wounded or hard-pressed, he will turn with great fury, and by springing on the elephant's head or shoulder endeavour to reach his antagonists. The agitation of the elephants, which often lose all obedience to control at such a moment, together with the rapidity of the attack, renders this a critical juncture, and fatal accidents have often embittered the conclusion of the contest.

THE SPOTTED HYÆNA.

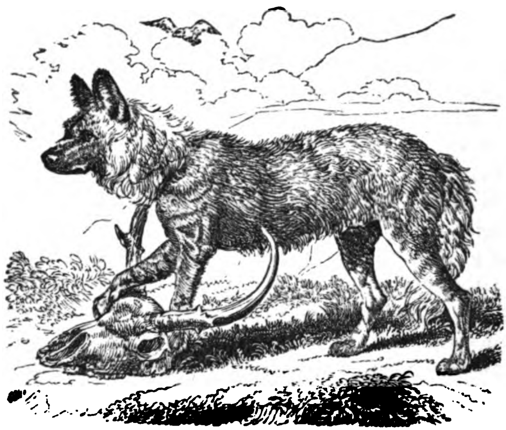


PERHAPS the most mischievous and destructive animal with which the settler in South Africa has to contend, is the spotted hyæna *(Hyæna crocuta)*, to which the colonists have given the name of the tiger-wolf, tolerably expressive of its fierce and ravening nature. This animal appears to occupy a position about mid-way between the cats and dogs, partaking much of the nature of both, as manifested in their natural state. It is a hideous, shaggy monster, with a voracious appetite, and a cry the most doleful and horrible that can be conceived, something that seems to be made up of fiendish laughter and the wail of condemned spirits. This is the nightly music to which the colonist must listen, and it is associated with all that is terrible and revolting to humanity; for the hyæna is not only the great marauder and destroyer of sheep and all domesticated animals, but the devourer of infants and infirm persons, as well as of dead bodies, whether human or bestial, and in any stage of decomposition. Prowling about the towns and the out-settlements, and often stealing into the very houses, it will seize whatever comes in its way, and make off to its lair on the mountains. The infant from its mother's breast, the sick person from the bed, and the corpse from the coffin, or recently filled-up grave, have often been thus mangled on the spot, or borne away to be devoured at home. It is a cowardly brute, and attacks no living creatures that make a bold stand against it. Even sick calves, and sheep that have been really unable to flee at its approach, or to manifest any sign of fear, have driven it off by stupidly looking in its face. With the Kaffirs it is a kind of sacred animal, and they expose their dead bodies, and even their sick and aged relatives, to be devoured by it; and, thus encouraged, it becomes bold, frequently entering the huts and carrying off children. Where fire-arms have been introduced, it has learned to live in wholesome dread of them; and a single man, with a gun, need not fear to encounter a host of hungry hyænas; they will scamper away in every direction; but he must not go to sleep in an unprotected spot in their vicinity, or they will soon be round him, sniffing and whining, with their fœtid breath, and horrid, blood-stained jaws, and green, glaring eyes, looking out for a vulnerable part. A story is told of a Cape trumpeter, who, having become dead drunk, was put out in the air to cool and recover himself: it was night, and the sharp-scented hyænas were soon attracted to the spot, and believing the man to be really dead, they dragged him away to the mountains for a feast. As they were about to commence operations, the trumpeter awoke to a sense of his agreeable situation, and sitting-up, did, perhaps, the most sensible thing which, under the circumstances, he could have done; he applied his instrument to his lips, and blew a shrill blast that made the rocks echo again, and his cowardly assailants to fly as if a musket-ball had been sent among them. The narrator of this story adds, that if the man had been anything but a trumpeter, he would, in all probability, have been devoured; but, from what we know of the hyænas, this seems unlikely, unless he had been so utterly stupified by drink, or paralysed by fear, as to have been incapable of making any resistance before some vital part had been reached. The jaws of this animal are so powerful that they are said to be able to crush the largest bones—of a horse even. A settler relates that when his horse was killed by a lion, only a small part of the carcase was devoured by the destroyer; but next night the entire remains were carried off by the hyenas, and all that was ever afterwards discovered was one of the hoofs and part of the skull.

The hyena is a very cunning and suspicious animal, so that it is not often taken in the traps and pitfalls set for it by the farmers; when it is, and its dead carcase is thrown to the dogs, they will not eat it, so rank and offensive is it. If, however, the dead body is left till night, its relatives will scent it out, and soon pick the bones quite clean, if they do not crunch and swallow them too.

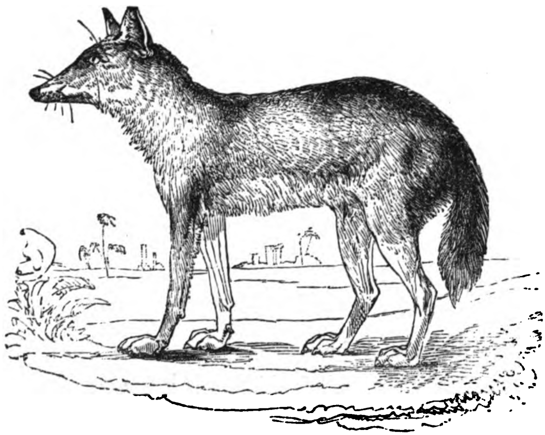
THE CAPE HUNTING DOG.

This is a wild, fleet, and savage animal, and one of the pests of South Africa, often committing fearful ravages on the flocks and herds of the farmers; when it breaks into the sheep-fold, it worries and mangles far more than it requires to satisfy its carnivorous propensities. It does not attack horned cattle openly, but steals behind, or upon them, when asleep, and, with a single bite, will snap off the tail, and scurry away to devour it in a place of security. Large packs of these wild dogs go scouring the country in all directions, sometimes by day, but oftenest by night, hunting the different kinds of antelopes, which they generally run down, being long-winded, as well as strong and fleet; they will attack and tear in pieces any disabled animal they come across, however large it may be; they are about the size of an English pointer, have long limbs, erect ears, and muscular, well-proportioned forms. Gordon Cumming describes their mode of hunting, and says "that their pace is a long, cantering gallop; and in the chase they relieve one another, the leading hounds falling to the rear when fatigued, when others, who have been husbanding their strength, come up and relieve them. Having succeeded in bringing their quarry to bay, they all surround him, and he is immediately dragged to the ground, and in a few minutes torn to pieces and consumed. They are of a bold and daring disposition, and do not entertain much fear of man, evincing less concern at his approach than any other carnivorous animal with which we are acquainted. When a pack is disturbed, they trot leisurely along before the intruder, repeatedly halting, and looking back at him. The females bring forth their young in large holes in desolate open places, and their burrows are connected with one another underground. When a troop of wild dogs observe a man approaching, they rush forth, with their young, even though the intruder should be close upon them, and retreat across the plain. Their voice consists of three different kinds of cry, each being used on special occasions; one is a sharp, angry bark, usually uttered when they suddenly behold an object which they cannot make out; another resembles the chattering of monkeys. This cry is emitted at night, when large numbers of them are congregated together, and they are excited by any peculiar occurrence, such as being barked at by domestic dogs. The third, and the one most commonly made, is a sort of rallying note, to bring the various members of the pack together when they have been scattered in following several individuals in a troop of antelopes. It is a peculiarly soft and melodious cry, yet, nevertheless, may be distinguished at a great distance: it very much resembles the second note of



the cuckoo, and, when heard in a calm morning, echoing through the distant woodlands, it has a very pleasing effect. They treat all domestic dogs, however large and fierce, with the utmost scorn, waiting to receive their attack, and then cleverly assisting one another, they generally rend them to pieces. The domestic dogs most cordially reciprocate their animosity, at what distance soever heard, even more than that of the lion, starting to their feet, and angrily barking for hours." Further, the wild dog is strong, and swift, and rapacious, only a shade less fearful and repulsive than the hyæna itself: the gnu and the eland, and the pallah, bound off when they hear the wild musical cry, and the tempest of pattering feet, which betokens the approach of the ravening pack; and even the fierce buffalo cowers among the reeds, fearful of their sharp fangs and overpowering numbers.

THE JACKAL.



The Jackal (*Canis aureus*) is another of these gregarious predatory creatures which give an infinity of trouble to the South African settler. Not so savage and repulsive as the hyæna; not so strong and bold as the wild dog—it yet, perhaps, is as mischievous as either. Much like a fox in appearance, it is so in character also; sly and wary, it steals by night into the poultry close, and carries off the feathered inhabitants; it gives chase to the sheep and antelopes, and any other defenceless creatures which it can, singly or in united numbers, overcome; it is likewise very destructive in the fruit-garden, being somewhat of an omnivorous feeder, and seems to have a particular partiality for grapes; pulls up the roots and vegetables in the kitchen-garden, and thus, in more ways than even the animals before named, with which it is often found associated, injures and annoys the husbandman. Its wild cry, like a shriek heard in the silence of the night, is something truly horrifying; bursting forth out of the thick forest, or the rocky kloof, or sweeping afar over the desolate karroo, it rises, and ere it dies away is taken up and repeated by echo; or one troop answers another, and is in turn answered from a different quarter, till the wild chorus fills all the air, and it seems as though demons were holding their revels in some weird spot near at hand. Away go the yelling pack, light of foot, keen of scent, and sharp of eye; if they light upon a sick or wounded animal of the larger kind, they stand shrieking round him, until the lion, guided by the sound, approaches, strikes down his prey, and having satisfied his hunger, leaves the rest for his noisy providers, as they have been called, who quarrel and fight over every morsel, and chase each other round the carcass for choice bits, all the while keeping up a terrific din. When the bones are picked clean, off they go again, with tails stretched out and noses high in air, sniffing the gale, and, as it seems, attending on the desert-king in his nightly roamings. When the daylight comes, they retire to their holes and burrows, and there lie crouched, until the night, their season for racing, feasting, and yelling, again approaches.

THE ELEPHANT.

Having thus disposed of the most important of the South African cats and dogs, and creatures most nearly allied to them, let us now turn our attention to a very different class of animals, those included by naturalists in the order *Pachydermata*, or thick-skinned, at the head of which stands the ponderous elephant, the most sagacious, and, when not molested and irritated, the most harmless of animals.

"Calm amid scenes of havoc—in his own
Huge strength impregnable, the elephant
Offendeth none, but leads a quiet life
Among his own contemporary trees;
Till Nature lays him gently down to rest
Beneath the palm which he has wont to make
His prop in slumber: there his relics lie
Longer than life itself had dwelt in them.
Bees in the ample hollow of his skull
Pile their wax citadels and store their honey;
Thence sally forth, to forage through the fields,
And swarm in emigrating legions thence.
There little burrowing animals throw up
Hillocks beneath the overarching ribs;
While birds within their spiral labyrinth
Construct their nests."

Such is the picture given of the quiet life, gentle death, and peaceful repose of the elephant in an eastern land, where the huge creature is less likely to be hunted and disturbed than in that quarter of the globe to which our attention is now directed. Here his mighty strength has never been turned to purposes of utility; here he is not looked upon with such kindly regard as in the east, where the idea of eating elephant's flesh would be revolting to all, and to a large class,—the Hindoos,—most wicked and impious. Here the great creature lives surrounded by enemies: the native tribes are constantly plotting his destruction, and the Europeans, with their deadly weapons, are yearly thinning his numbers. "This day," says Gordon Cumming, "I bagged my *fiftieth* elephant;" and we read of 300 being killed every year on the banks of a small river. 150,000 lbs. weight of ivory, chiefly elephant's tusks, are exported annually from Quillimane, on the eastern coast of Africa; and the staple article of trading, with every native chief, is ivory. The Bechuanas, and other African people, followed the white hunter by hundreds, in order to secure the flesh of the elephants which he might kill; and on every hand, as we pass with the traveller through the wild country, we find snares, and pitfalls, and other contrivances for destroying the elephant. And no less in league against him are his fellow denizens of the forest and the sandy plain. Should he fall lame or sick, and become unable to defend himself, he will be attacked and killed at once by the lion, ripped by the rhinoceros, gored by the buffalo, or worried to death by the leopards, hyænas, wild-dogs, and jackals, to whom his immense carcass affords a plentiful feast. Under these circumstances, one is astonished at the immense number of elephants which are yet met with in South Africa. Large herds of from fifty to one hundred roam the grey, dreary forests, and rocky pastures of the Bamanguato, and other countries in that region. In his journey along the northern banks of the Zambesi, Dr. Livingston and his party had to shout to the elephants to get out of their way. About Tete, as the Doctor tells us, there are plenty of elephants; and he had no fear of leaving his party of Makololo there until his return from Europe, because they were expert hunters, and would be sure to get their own living, in a great measure, no doubt, at the expense of the poor elephants.

The inaccessible nature of the wild tracts of country which they inhabit has proved a great safeguard to these huge creatures, as well as the extraordinary horror which they appear to entertain of the presence of man. Gordon Cumming says that "a child passing at a quarter of a mile to windward will put a hundred of them to flight; and when thus disturbed, they go a long way before they halt: it is surprising how soon these sagacious animals are aware of the presence of a hunter in their domains. When one troop has been attacked, all the other elephants frequenting the district are aware of the fact within two or three days, when they all forsake it, and migrate to distant parts, leaving the sportsman no alternative but to inspan his wagons, and remove to fresh ground: this constitutes one of the greatest difficulties a skilful elephant-hunter encounters. Even in the most remote parts, which may be reckoned the head-quarters of the elephant, it is only occasionally, and with inconceivable toil, that the eye of the hunter is cheered by the sight of one. Owing to habits peculiar to himself, the elephant is more inaccessible, and much more rarely seen than any other wild animal, excepting certain rare antelopes; they choose for their resort the most lonely and secluded depths of the forest, and generally at a great distance from the rivers and fountains at which they drink. In dry, warm weather, they visit these every night; but in cool, cloudy weather, they drink only once every third or fourth day. About sundown the elephant leaves his distant mid-day haunts, and commences his march towards some fountain, which is, probably, from twelve to twenty miles distant; this he generally reaches between the hours of nine and midnight; when, having slaked his thirst and cooled his body by spouting volumes of water over his back with his trunk, he resumes his path to his forest solitudes." Our observant hunter says that, in very secluded districts, they usually lie down on their sides, and sleep for a few hours. It does not appear that the females do this; and in districts where they are likely to be disturbed, they all take repose standing beneath some shady tree. "Having slept," he says, "they feed immensely, spreading out from one another; and, proceeding in a zig-zag course, they smash and destroy the forest trees which happen to lie in their way. The number of these which a herd of bull elephants will thus destroy is utterly incredible. They are extremely capricious; and on coming to a group of five or six trees, not unfrequently break down the whole of them, when, having perhaps only tasted one or two small branches, they pass on and continue their wanton work of destruction." He also relates, that "he has several times gone into forests, where the trees thus broken lay so thick across one another, that it was almost impossible to ride through them; and it is in situations such as these that attacking the elephant is attended with most danger. During the night they will feed in open plains and thinly wooded districts; but, as day dawns, they retire to the densest covers within reach, which, nine times in ten, consist of impracticable wait-a-bit thorns; and here they remain, drawn up in a compact herd, during the heat of the day. In remote districts, and in cool weather, herds will continue pasturing throughout the whole day."

It must, indeed, be a magnificent sight to behold these immese creatures in all the freedom of their native wilds, slowly passing from glade

to thicket, or out in the open plain, ploughing up the ground with their mighty tusks, in search of roots, or using them as levers wherewith to overthrow the trees, on whose tender shoots and branches they love to feed; to mark their unwieldy gambols and playful caresses—for this

> " Beast, which hath between his eyes
> A serpent for an arm.

has its frolicsome and tender moments, as well as animals of more graceful and elegant proportions. The elephant calves are very playful, and may be seen rolling over and over, and chasing each other amid the rocky ridges and wooded hollows of their native haunts, like so many lambs. They have softly modulated tones, these mighty Behemoths, in which they address each other in accents of tenderest affection.

But such an immense and powerful creature is this, that in its love and anger it is alike terrible; when excited, by passion of any kind, to an exercise of its great strength, woe be to whatever stands in its way. When it would open a path to the object of its desire, or pursue an enemy, trees are overthrown like reeds, and stones and rocky fragments of immense size hurled aside like very toys. He must be a bold man who would venture on foot into the maze of uprooted trees and thorn-bushes above described, to face and destroy an angry elephant; and such was Gordon Cumming, perhaps the most successful hunter of this animal that ever lived.

But then, the ivory! Ah, think of a pair of tusks, eight or nine feet long, and six inches in diameter,—what a prize is this! A prize, indeed, and yet we, for our parts, would rather sit at home, and let the poor elephants range their native wilds unobstructed, than go forth and encounter such risks, hardships, and dangers, for its possession. It is well, no doubt, that there should be adventurous spirits like Gordon Cumming; there is a work appointed for all to do, and this seems to be theirs—to battle with the wild creatures of the forest and the desert, and to extirpate, or to bring into subjection, those whose unrestrained existence would be adverse to the advancement of human civilisation, of which they often act as pioneers. "A herd of elephants, browsing in majestic tranquillity amid the wild magnificence of an African landscape, is a very noble sight," says Pringle, "and one of which I shall never forget the impression." And Cumming tells us, that "the appearance of the wild elephant is inconceivably majestic and imposing; his gigantic height and colossal bulk, so greatly surpassing all other quadrupeds, combined with his sagacious disposition and peculiar habits, impart to him an interest in the eyes of the hunter which no other animal can call forth. His pace, when undisturbed, is a bold, free, sweeping step; and from the spongy formation of his foot, his tread is extremely light and inaudible, and all his movements are attended with singular gentleness and grace. This, however, only applies to the elephant when roaming undisturbed in the jungle. When roused by the hunter, he proves a most dangerous enemy.

Such is the *Elephas Africanus*, as naturalists call this African species, which is distinguished from the *E. Indicus*, its Indian congener, mainly by its rounded head, large ears, and three hoofs on the hind feet, the Asiatic species having four. Like most large animals, the elephant is of slow growth: it has been said not to attain full maturity until the age of thirty years, and has been known, in a state of confinement and servitude, to live to six score. Of its great sagacity, innumerable instances are on record, making us doubtful where to draw the imaginary line between instinct and reason. Endowed with keen senses, and, as it seems, fine sensibilities also, we find in this animal a kindly, genial, and gentle nature, beneath a most unprepossessing exterior, teaching us, again, that outward show has little to do with inward qualities.

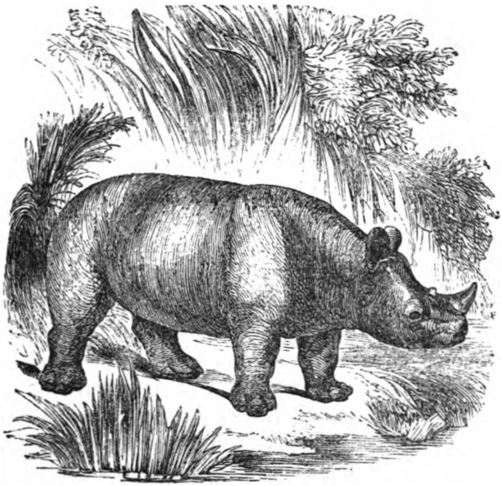
RHINOCEROS.

Next to the elephant in size, and belonging to the same thick-skinned family, is the rhinoceros, a huge, unwieldly, brute, with a most unprepossessing exterior, a morose and sullen temper, and habits filthy and disgusting; delighting to wallow in the mire, with which its warty, tuberculated hide is generally plastered, and to plough up the ground with its horny snout; it goes routing and grunting about amid the swamps and gloomy forests, like a very pig, as it is; and a most irascible pig, too; for, if you come in its way, it will charge right at you, without regard to consequences. "Canst thou bind the unicorn with his band in the furrow? or will he harrow the valleys after thee? wilt thou trust him because his strength is great? or wilt thou leave thy labour to him?" asks the afflicted patriarch of Uz, evidently alluding to this animal, which, if were as tractable as it is strong, might be of great service to the husbandman. But the asker of these questions well knew the fierce and untameable nature of the animal to which he alluded. "Will he harrow the valleys after thee?" not he—that is, for any useful purpose; but he will plough up the ground, and cut the bushes to pieces, in his fits of ungovernable fury, seeming to take a savage delight in such an exercise of his brute strength.

Naturalists pretty generally agree in giving Africa three distinct species of rhinoceri, all of which are found in the southern portion of the continent. The black, one-horned species, *Rhinoceros bicornis*, appears to be the most common; the native name for it, according to Cumming, is *Borèlé*. The Keitloa (*Rh. keitloa*), is also black, and has two horns; as likewise has the white rhinoceros (*Rh. simus*), whose native name is *Muchocho;* but then we read in Cumming's book of another white species, or perhaps it is but a variety, which the Bechuanas and others call *Kobaoba*—a most hideous creature this, with an indescribable head, and one of its horns three or four feet long. We also hear of a three-horned rhinoceros in Africa, and are induced to think that this is but an accidental variety.

The rhinoceri do not, like the elephants, associate in herds; they generally go singly, or in pairs: sometimes five or six may be seen

together, and even more, where pasturage is fresh and abundant, in districts where they are numerous. "During the day they may generally be found in some retired part of the forest, lying asleep, or reclining indolently against a tree; sometimes it is under the base of a mountain, sheltered from the sun by some friendly umbrella-topped mimosa. In the evening they commence their nightly rambles, and wander over a great extent of country, visiting the fountains at night, between the hours of nine and twelve, and then it is that they may be successfully hunted with the least danger." The skin of this animal is so thick that bullets will not penetrate, if made wholly of lead. Cumming hardened his with solder: yet none of the African species have those overlapping folds of skin which the Asiatic have. These latter are all, we believe, single-horned; a species with one horn only has been spoken of as African, but we do not know that it has been met with far south. The Keitloa is said to have the two horns of a nearly equal length; while in the commoner black species the posterior one, in both sexes, is never much beyond a third of the length of the anterior; the neck is also much longer than that of Borèlé, whose portrait we here give.



THE HIPPOPOTAMUS.

As large as the rhinoceros, and as hideous in appearance, but far less ferocious and destructive, is the Hippopotamus, or River-horse, which is found in nearly all the great rivers in Africa whose banks have yet been visited by Europeans. This is the *Hippopotamus amphibius* of naturalists, a creature which sometimes weighs more than fifteen hundred pounds, and has a skin, in places, as much as two inches thick, with a body like a dirty barrel set upon short, thick legs; a monstrous head, for which we can find no similitude on the earth, or in the waters under the earth; a little pig-like tail; small eyes, situated high up in the head; a muzzle much swollen; great thick lips studded with wire-like bristles; an enormously wide mouth, which, when open, as it commonly is, exhibits sharp incisor teeth, and huge curved tusks, which, when the animal is excited, are capable of committing fearful mischief; the ears are small, and furnished with a few wiry bristles; on each of the immense feet are four toes, tipped with horny hoofs, which leave a deep imprint in the mud of the river's brink, and sand of the sea-shore, where the creature is as often seen as by the fresh-water streams in the interior; hence the name Sea-cow is often given to it, showing that it is in its habits marine as well as fluviate.

It does not appear that the hippopotamus has been found out of Africa, where it is very abundant, although now more limited in its range and habitat than it was formerly. It is gregarious in its habits, sagacious, wary, and cautious.

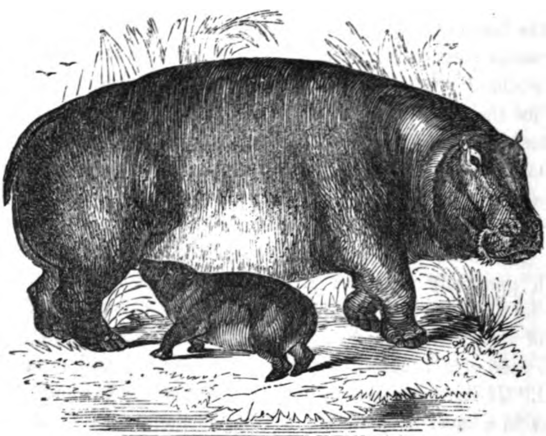
"To convey some idea of the numbers in which these animals were found, on several of the rivers toward the tropic of Capricorn," says Dr. Smith, "it may suffice to state, that, in the course of an hour and a-half, a few members of an expedition-party killed seven within gun-shot of their encampment. Several other individuals were in the same pool, and might also have been killed, had it been desirable. One of the survivors was observed to make his escape to an adjoining pool; and, in accomplishing this, he walked, with considerable rapidity along the bottom of the river, and with his back covered with about a foot of water." The animal does not remain thus submerged more than five or six minutes at a time, being obliged to come to the surface for the purpose of respiration; and then it is that the hunter, who watches for the opportunity, endeavours to plant the fatal shot. Cumming, we may remember, first came upon hippopotami on the Limpopo, and he describes them as there tolerably abundant, but very difficult of approach. The scene which he presents to us in the following passage, must have been a grand and impressive one:—"At sun-down, the sea-cows commenced their march up the river, passing opposite our camp, and making the most extraordinary sounds—blowing, snorting, and roaring; sometimes crashing through the reeds; sometimes swimming gently, and splashing and sporting through the water. There being a little moonlight, I went down, with my man, Carey, and sat some time by the river-side. It was a truly grand, and very extraordinary scene; and the opposite bank of the stream being clad with trees of gigantic size and great beauty, they added greatly to the interest of the picture."

A few days after, our hunter shot his first hippopotamus, and had a most difficult task to secure his wounded game, dashing into the water, notwithstanding the danger of crocodiles, and holding on first to the creature's short tail, and then by two incisions which he made in the thick skin, and being whirled about as the maddened animal plunged and struggled, as if he had been a fly settled upon her tail. At length he succeeded in bringing his prize to the bank, and, afterwards, in getting the huge carcass drawn up high and dry. He was astonished at her enormous size: she appeared to be about five feet across the belly; and he could "see much beauty in her conformation, so admirably adapted for the amphibious life to which she was destined by nature."

The flesh of this animal is excellent, and in much request, not only by the natives, but by the European settlers. Indeed, the epicures of Cape Town, as Dr. Smith informs us, are very solicitous to obtain of the farmers at the out-settlements, *sea-cow's spec*, as the layer of fat found between the flesh and the skin is called, when salted and dried. Although generally harmless if unmolested, yet, when attacked, or alarmed for the safety of its young, this is a truly formidable animal, on account of its great strength and enormous size. It has been known to seize the side of a boat with its tremendous jaws, and crush it like an egg-shell. If hard pressed on land, it will run open-mouthed upon its assailants in a most desperate and furious manner; and unless it can then be shot down, the onset is perfectly irresistible.

Many stories have been told of the enmity which exists between the crocodile and friend Hippo, and of the deadly fights which sometimes take place between the behemoth and the leviathan of Scripture; but Cumming, and others, who have had the best opportunities of observing the habits of these creatures, report that they appear to be very good friends and neighbours, living comfortably together in their own peculiar domains—the river beds and reedy swamps of Africa.

The hippopotami, according to Dr. Smith, feed chiefly on grass, resorting to situations near the banks of rivers which supply that food. "In districts fully inhabited by man," says the Doctor, "they generally pass the day in the water, and seek their nourishment during the night; but in localities differently circumstanced, they often pass a portion of the day as well as the night on dry land. In countries in which the night constitutes the only safe period for their leaving the water, they are generally to be seen effecting their escape from it immediately before dark, or are to be heard doing so soon after the day has closed, and according to the state of the surrounding country; they then either directly commence feeding, or begin a journey towards localities where food may exist. When, previous to nightfall, they may have been in pools or rivers, they are generally at once enabled to commence feeding on reaching the dry land; but when they may have passed the



day in the sea, they require commonly to proceed some distance after leaving it, before they find grass which appears congenial to their palate. It is not every description of grass that hippopotami seem to relish; they often pass over, in search of food, luxuriant green swards which would strongly attract many other animals which feed upon grass. Besides having a peculiar relish for the grasses of certain situations, they appear to have a predilection for districts supporting brushwood; and owing to the latter peculiarity, they are often found wandering in localities on which but little grass exists, when they might have it in the neighbourhood in great abundance, and wanting the accompaniment of wood."

THE SOUTH AFRICAN PHACOCHÆRE.

This is an animal which, on account of its extreme ferocity, cunning, and impetuosity of attack, and the formidable tusks with which it is armed, is much dreaded by both natives and Europeans. The length of the head and body is about five feet, and of the curled tail eleven inches or so. Of its general appearance, horrid and bristly, the annexed cut will give our readers a good idea.

We here see it charging, as its custom is, when suddenly surprised by the hunter, or brought to bay after a run, headlong upon its foe, striking with the sharp tusks, the upper pair of which stand about eight inches out of the jaw, and the lower pair about three inches. It has been known to cut completely through the fleshy part of a man's thigh at a single stroke, and rip up the belly of a horse. "The natives," says M. Pallas, "would rather attack a lion in the plain than a wild boar; for this, though much smaller, comes rushing on a man as swift as an arrow, and throwing him down, snaps his legs in two, and rips him up before he can get to strike it and kill it with his javelin."

The dwelling-place of this fierce and dangerous animal is under ground, and it always lies with its head to the entrance of the cave, ready to rush forth upon all and sundry, who incautiously approach thereto.

The authority just quoted mentions a curious fact, which shows that, with all its natural ferocity of character, this boar is not wanting in love for its offspring.—"This day I pursued several young pigs with a sow, to shoot one of them; but in vain. On a sudden the heads of the old ones, which before were of a tolerable size, seemed to have grown still larger and more shapeless than they were before; which momentary and wonderful change astonished me so much the more, as my hard riding over a country full of bushes and pits had hitherto prevented me from giving sufficient attention to the manner in which it was brought about. The secret, however, consisted in this:—Each of the old ones, while they were making off, took a pig in his mouth; a circumstance which also explained to me another subject of my surprise, viz.. that all the pigs which I was just before chasing along with the old ones had disappeared."

The favourite feeding-time of this animal appears to be early in the morning and late in the evening, and through the night, if it be moonlight, although in districts where fire-arms have not been introduced, it may be met abroad in the daytime. The colonists eat its flesh, as do the Bechuanas and some other tribes; but the Kaffirs regard it as unclean, reminding one of the Jewish practice with regard to swine's flesh.

THE POLAR BEAR.

Within the regions of the Arctic Circle dwells the Polar Bear, one of the largest and most formidable of the species. Formed to endure the most intense severity of cold, this monarch of a gloomy, desolate realm, prowls in sullen majesty over wastes of snow and among ice-glazed rocks in quest of food; he traverses fields of ice along the shore, clambers over rugged icebergs, or even swims out from floe to floe, or from island to island, ravenous for his prey. He dives with admirable address, and is capable of contending with his prey amidst the rolling waves. The seal forms his favourite diet, together with marine exuviæ, such as dead fishes and cetaceous animals; and he will attack even the walrus himself.

In summer mountain-berries are eagerly sought for, nor are sea-weeds or marsh-plants rejected. Of the activity of this bear in the water we may form an idea from a statement by Cartwright, that he saw a polar bear dive after a salmon and kill his fish.

Captain Lyon gives the following account of its mode of hunting the seal:—"The bear, on seeing his intended prey, gets quietly into the water, and swims until to leeward of him, from whence, by frequent short dives, he silently makes his approaches, and so arranges his distance, that, at the last dive, he comes to the spot where the seal is lying. If the poor animal attempts to escape by rolling into the water, he falls into the bear's clutches; if, on the contrary, he lies still, his destroyer makes a powerful spring, kills him on the ice, and devours him at leisure." The same author informs us that this bear not only swims with rapidity, but is capable of making long springs in the water. Captain Sabine states that he saw one about midway between the north and south shores of Barrow's Straits, which are forty miles apart, though there was no ice in sight to which he could resort for rest.

The pace of this bear on shore is a kind of shuffle, but more quick than might be expected; and when at full speed as rapid as the sharp gallop of a horse.

The average length of the polar bear (which has been greatly exaggerated) is about six feet, but it occasionally attains to larger dimensions. Pallas describes an adult female six feet nine inches in length. The greatest length, from nose to tail, recorded by Captain Phipps, is seven feet one inch; the weight of the beast being 610 lbs. Captain Ross records the measurement of one seven feet ten inches, the weight being 1160 lbs.; and Captain Lyon, that one, which was unusually large, measured eight feet seven inches and a half, and weighed 1600 lbs.

It is stated on the best authorities, that the male does not hybernate, but that the female, on the approach of the severer season, retires to some rift among the rocks or ice, or digs a lair in the frozen snow; the falling snow drifts over the den, covering it to a great depth, a small aperture for breathing being always open. In this retreat about the latter part of December she brings forth two cubs, and in March quits the den with them, then about as large as a shepherd's dog, and prowls abroad, lean, gaunt, and ferocious; hunger and the presence of her offspring adding fury to her savage temper.

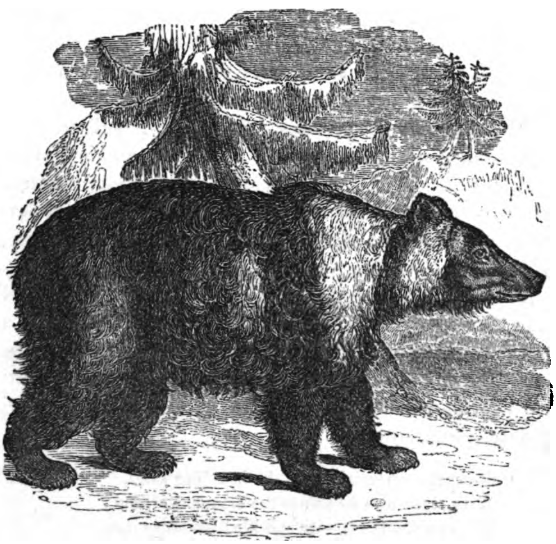
The male wanders about the marshes and adjacent parts until November; he then goes out to sea upon the ice in quest of seals, and becomes very fat. It often happens that he becomes drifted out from the coast on a floating field of ice; and in this way, says Dr. Richardson, polar bears are often carried from the coast of Greenland to Iceland, where they commit such ravages on the flocks, that the inhabitants rise in a body to destroy them.

Of the devotion of the female polar bear to her young, and of the danger attendant upon the chase of these animals, many travellers have

made mention, and recorded many facts which came under their own observation. These, however, are so popularly current, that it is sufficient to allude to them.

It was not until Linnæus published the tenth edition of his "Systema Naturæ," that he had any idea that the polar bear was distinct from the brown bear, the only species he appears to have known. Martens, however, had previously distinguished it, and indeed was the first to characterize it from actual observation—("Spitzbergische oder Grönländische Reisebeschreibung," Hamb., 1675).

This species is of a more lengthened form than that of the others; the head is very much elongated and flattened, the ears and mouth comparatively small, the neck very long and thick, and the sole of the foot very large. The fur is silvery white, tinged with yellow; close, short, and even, on the head, neck, and upper part of the back; long, fine, and inclined to be woolly on the hinder parts, legs, and belly. The sole of the foot is almost entirely covered with long hair, affording the animal a firm footing on the ice. The claws are black, not much curved, thick, and short. Captain Lyon's crew found none of the terrible effects (skin peeling off, &c.) from eating the flesh, ascribed to it by some of the earlier voyagers.



THE SIBERIAN BEAR.

The Siberian Bear approaches close in form to the Brown Bear, a native of the barren islands lying northward and eastward of the Great Slave Lake and extending to the Arctic Sea, the only distinction being a large, whitish collar, which passes over the upper part of the back and shoulders of the Siberian Bear, and is completed on the breast. This is not improbably a variety.

THE CROCODILE.

We have spoken of the Crocodile, the Leviathan of Scripture, that huge scaly monster which is found, we believe, in all the great rivers in Africa, and sometimes attains the enormous length of thirty feet. Like its congeners of the Ganges and the Amazon, the crocodile of Africa, called by naturalists *Crocodilus vulgaris*,, is a sluggish animal, delighting to lie basking in the sun, on a mud bank, or a reedy isle; and there, until the white man came with his rifle, it might lie in safety, for no animal would venture to attack it, and the weapons of the occupiers of the waters would avail them little against such a coat-of-mail as this creature possesses, the overlapping bony plates covering the whole of the upper part of the body—not to speak of the danger of venturing within reach of the monster's jaws, and immense spiny tail, a single blow with which would be certain destruction. Cumming found crocodiles plentiful in the Limpopo, consorting peacefully with the hippopotamus, and shot several, the largest being about eighteen feet long, with a body as thick as that of an ox. These animals, as is pretty well known, are carnivorous and oviparous, flesh-eaters and egg-layers; their presence in the rivers renders crossing very dangerous; and many an unfortunate traveller has been bitten in twain by their far-protruding, well-armed jaws, which may be often observed above the muddy water, or amid the rank vegetation, when the rest of the hideous body is altogether hidden from view. The crocodile of the Nile was an object of adoration with the ancient Egyptians. Of its appearance and habits, the following lines are finely descriptive :—

> "Erewhile, emerging from the brooding sand,
> With tiger-paw he prints the brineless strand;
> High on the flood, with speckled bosom swims,
> Helmed with broad tail, and oar'd with giant limbs;
> Rolls his fierce eye-balls, clasps his iron claws,
> And champs, with gnashing teeth, his massy jaws:
> Old Nilus sighs through all his cane-crown'd shores,
> And swarthy Memphis trembles and adores."

The upper part of the body of the crocodile is of an olive green, sprinkled with black on the head and neck, and marked with the same colour on the back and tail. Two or three large oblique black bands show themselves on each flank. The lower parts are of a greenish-yellow.

THE ZEBRA, OR QUAGGA.

Of the horse tribe, or genus *Equus* of naturalists, there are three species in Africa—viz., the mountain zebra (*E. montanus*), the zebra of the plain (*E. zebra*), and the quagga (*E. quagga*). Between the two former species there seems to be some confusion, their characteristic differences, if such exist, not having been clearly pointed out. In the latter, the stripes on the skin are by no means so uniform and distinct, nor do they cover so much of the body, All of these wild asses, as they may well be called, are extremely beautiful and graceful creatures. Swift as the wind, they scour the arid plains, and bound through the rocky wildernesses, their fleet feet being their only safeguard against many dangers. They go in troops; are watchful and wary; are said to consort much with the ostrich, whose great quickness of sight is supposed to be serviceable in detecting approaching danger. Let the alarm be taken, and off they set, in a whirlwind of sand raised by their nimble hoofs, leaving pursuers far behind. Like the different antelopes, they are hunted by both natives and Europeans, for the sake of their flesh, which resembles young beef. Pringle, in some lines which we have already quoted, speaks of—

> "The timorous quagga's shrill whistling neigh,
> Heard by the fountain at twilight grey."

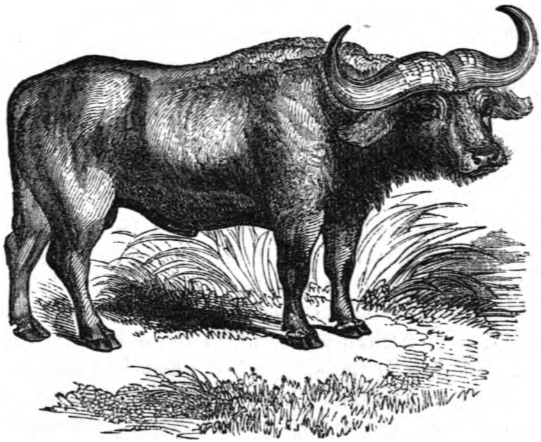
And well, at such a time, may the wild ass of the desert be timorous; for then it is that the lion, arousing from his lair, and the wild dogs, and the leopards and hyænas, are sallying forth for their nightly, ravages; and some of these furious animals will soon be on the track of the zebras and their relatives.

> " Scourers of the desert wide,
> Untamed steeds that bear no rein;
> Never man on you may ride,
> Never bit may you restrain.
>
> With fleet feet, ye spurn the sand,
> As with flying manes ye go
> Far across the barren land,
> To the rocks whence fountains flow.
>
> From the feathered shaft away.
> From the bushman's poisoned dart,
> Who your headlong speed shall stay?
> Who shall drive your troops apart?"

THE ORYX.

The Oryx is a straight-horned antelope, in shape much like a wild ass. It has a broad, black band on either cheek, which, united with a patch of the same colour on the forehead, gives the animal a very peculiar appearance, as if it wore a visor. A bold and powerful antelope is this, using its sharp horns, which are about three feet long, with great energy and address; frequently killing several of the hunter's dogs before he can get within shot of it. The colonists call this the gemsbok: it is mostly found to the south of the Orange river, on the desolate karroo, where Cumming hunted, and found it most difficult game to shoot, on account of its wariness and swiftness. He says, "In the whole course of my adventures with the gemsbok, I only remember four occasions, when mounted on the pick of my stud (which I nearly sacrificed in the attempt) that, alone and unassisted, I succeeded in riding the oryx to a standstill." The plan generally adopted by the Boers is, to place light Hottentots or Bushmen on horses of great endurance, and literally course the antelope, as they do stags in Scotland, with the strong, rough deer-hounds.

THE CAPE BUFFALO.



One member of the ox tribe only do we find in South Africa—this is the Cape Buffalo (*Bos kaffir*), a most powerful and ferocious brute, which is generally found in herds amid the tall reeds of the swampy grounds, wallowing in the muddy pools. It is one of the most dangerous animals with which the hunter comes in contact, seldom being struck down by a single shot, and, when it is once wounded, often feigning death in order to lure its assailant within reach, when it will start up and attack him with the utmost fury.

We give a good representation of this wild African ox, and the picture is by means prepossessing: a body of great bulk, set upon short, stout legs; a thick neck, like the breast, shaggy with hair; a pair of tremendous horns, meeting at the base, and spreading out widely, so as to form a helmet for the head, and then curving upward and inward, and terminating in sharp points; close beneath this horny helmet glow the lowering eyes like live coals; and then, at the bottom of this ponderous head is the broad muzzle, around which and the under-lip gather the harsh, greyish black hairs, so as to form a scanty beard—altogether a vicious looking creature, as indeed it is. Many stories do the colonists tell of its ferocity; how it rushes out from its hiding-place amid reeds, upon any one who approaches the spot, and should the person attacked not be nimble enough to escape from its desperate charge, gores and tramples him to death, leaving the body and returning to it again and again, as if it could not sufficiently satisfy its malevolence. Although so heavy and stoutly made, the Cape buffalo is a fleet runner, and when pursued by the hunter, rushes through the thicket and up the mountain side at a prodigious rate, carrying all before it; when it is the pursuer, a good horse has to exert all his powers to keep a-head of the savage beast, and should a miss-step and a fall take place, the bull comes thundering down upon the fallen animal, and with hoofs and horns generally makes an end of it. All this renders buffalo-hunting a most exciting sport; and so much has it been followed by the colonists, that the animal has been driven far into the interior, where it is found in the wild forests and prairie lands in company with the elephant, and other of the larger kinds of African game, which retire before the advance of cultivation. The lion is the only animal which will venture to attack the buffalo, and even this mighty brute will not do so unless he can spring upon it from behind, and so avoid the thrust of its formidable horns. Sometimes a buffalo, when thus attacked, will be aided by others of the herd, and the lion gets the worst of it, having been found gored to death by numbers. The Hottentots prefer hunting the buffalo on foot, as they can more easily make their escape from the furious charges amid the narrow openings of the thickets and swamps, amid which it is generally found, when not in the rocky glens and ravines, which are also favourite haunts with this beast, whose flesh is valuable as an article of food, and its thick hide for rheimpies or ropes, and other purposes. Cumming had several perilous adventures with this animal; he thus details one of them:—

"We had an adventure with an old buffalo, which shows the extreme danger of hunting buffaloes without dogs. We started him in a green hollow among the hills, along the base of which we followed him, sometimes in view, sometimes on the spoor, keeping the old fellow at a pace which made him pant. At length, finding himself much distressed, he had recourse to a singular stratagem. Doubling round some thick bushes, which concealed him from our view, he found himself close to a small pool of rain-water, just deep enough to cover his body; into this he walked, and, facing about, lay gently down and awaited our on-coming, with nothing but his old grey face and massive horns above the water, and these concealed from view by rank over-hanging herbage. Our attention being entirely engrossed with the spoor, we rode boldly on until within a few feet of him, when, springing to his feet, he made a desperate charge at Ruyter, uttering a low, stifled roar, peculiar to buffaloes (somewhat similar to the growl of a lion), and hurled both steed and rider to the earth with fearful violence. His horn laid the poor horse's haunch open to the bone, making a most fearful ragged wound. In an instant Ruyter regained his feet, and ran for his life; this the buffalo observed, and gave chase, but most fortunately came down with a tremendous somersault in the mud, his feet slipping under him, and thus the Bushman escaped certain destruction. The buffalo rose much discomfited, and at this moment I managed to send one of my patent pacificating pills into his shoulder, when he instantly quitted the field of action, and sought shelter in the dense cover of the mountain side, whither I deemed it imprudent to follow him."

Not so fortunate as Ruyter was one of a party of Boers, of whom Mr. Moffat, the missionary, relates that, when hunting this animal, he was pursued by it; he fled through a quagmire, and endeavoured to climb a mimosa-tree which stood at the end of it; but the raging beast was too quick for him, and catching him on its terrible horns, tossed him into the air with such fearful violence, that he fell into the cleft of the tree a mangled and lifeless body.

THE CANNA.

The Canna is the eland or elk of the colonists, and the Sinpoof of the Kaffirs. It is the largest of all the antelopes, being full five feet high at the shoulder, and sometimes weighing as much as nine hundred-weight.

The male has large and heavy horns, about a foot and a half long; they are wreathed spirally, but not curved. In the female, the horns are much smaller, and nearly plain. The neck is thick, compressed at the sides, as in the ox, and there is a large protuberance on the throat, and a hanging dewlap. All along the back, which is humped, from the forehead to the tail, runs a short, erect mane of dark-brown hair: the tail ends in a black tuft. The general colour of this animal is a reddish fawn above, and white on the under parts, with an ashy-grey tint about the head and neck. No venison is reckoned so fine as the flesh of the

Eland, which is, consequently, much sought after. It is a mild, inoffensive creature, going in large herds, the males generally keeping apart from the females and young. Browsing upon the plains and low hills, and leading a somewhat inactive life, it becomes very fat, and is said frequently to die of plethora, especially when hard run,—at which times, it is said, a red oily perspiration issues from the pores of the skin. These animals are so unsuspicious—may we call it, confiding?—that a sportsman may ride into a herd, and single out the fattest males; and so often has this been done, that it is said there are some herds without a male amongst them. Dr. Livingston found the elands plentiful in the Barotse country, and all about the Zambesi. As we have already noticed, he speaks of their tameness as shocking to see in wild animals.

Gordon Cumming met with this antelope on several occasions, but not often, as we should gather from his general silence respecting it. No doubt, the high regard in which its flesh is held would tend greatly to thin its numbers in all those tracts within reach of the colonists. The parts most esteemed by epicures are the large muscles of the thighs, which, when cured and salted, are called thigh-tongues, on account of their peculiar flavour and fineness of grain.

THE KOODOO.

The Koodoo is another noble antelope, measuring about four feet high at the shoulder: it has a splendid pair of horns, frequently as much as four feet long; they are very thick at the base, and beautifully twisted into wide-sweeping spirals, consisting of about two turns and a half in the whole length; a prominent ridge or keel follows their flexure, as seen in the cut.

The Koodoo, or Kudu, as it is sometimes spelled, perhaps more in accordance with the pronunciation, is a haunter of the wooded tracts which follow the course of rivers; on all those of Kaffraria it is found, and also of other countries further in the interior. It feeds on the shoots and leaves of trees and bushes; and lives in family groups of five or six. Although heavy, it leaps with wonderful agility, and when pressed takes to the water and swims vigorously; if brought to bay, it is formidable, on account of its great strength and determination, and the immense weapons with which nature has furnished it. A light fallow brown is the prevailing colour of this antelope; there is a snow-white ribbon along the spine, the inner parts all light, and there are silvery-grey markings here and there.

THE BLESSBOK.

Of the true antelopes, there are in South Africa several species, which must now be briefly particularised. One of the handsomest and commonest is the Blessbok, which is often called by the colonists the Bontebok, or painted goat, on account of the singular disposition of the colours of the head and body, which appears as if laid on in distinct patches. A brilliant reddish-brown, deepening at places into quite a purple tint, is the prevailing colour of this beautiful animal: around either eye is a ring of white, which spreads off down the cheeks in a mark like that on horses, called a "blaze;" and hence its common name Blazebuck, or, as the Dutch say, Blessbok. The muzzle is white, as are the under parts of the body, and there is a disc of the same around the tail, giving occasion for the name, *A. pygarga*, by which naturalists distinguish this animal.

A glance at this representation of the Blessbok will show that it is a fleet-footed creature. One can fancy with what swiftness it would go bounding off with such long and slender limbs to bear it. "It is," says Cumming, "one of the true antelopes, and all its movements and paces partake of the grace and elegance peculiar to that species." This hunter describes it as being as large as an English fallow-deer. "It differs," he says, "from the Springbok (presently to be described), in the determined and invariable manner in which it scours the plains, right in the wind's eye, and also in the manner in which it carries its nose close to the ground. Throughout the greater part of the year," he continues, "the blessboks are very wary and difficult of approach, but more especially when the does have young ones. At this season, when a herd is disturbed, and takes away up the wind, every other herd in view follows it; and the alarm extending for miles and miles down the wind to endless herds beyond the vision of the hunter, a continued stream of blessboks may often be seen scouring up-wind for upwards of an hour."

Our hunter found it very difficult to get within shooting distance of this swift and wary creature, the flesh of which is fat and delicate: he brought down an old buck running at two hundred yards, and was delighted with its beauty, which nothing could exceed. "Like most other African antelopes, its skin emitted a delicious and powerful perfume of flowers and sweet-smelling herbs; a secretion issues from between its hoofs, which has likewise a pleasing perfume."

Such is the blessbok, once very common within the district of the Cape Colony, and still, as we learn from Cumming's account, extremely numerous in the open plains beyond. It carries a pair of horns about sixteen inches long, large and regularly lyrated. In the annexed cut they are represented as not fully grown, the animal being a young one.

We will now speak of the Springbok, called by naturalists *Antelope enchore*. This, too, is a most graceful and beautiful antelope, a native of the wild karroos, where it lives in vast troops, which migrate irregularly, so that a plain on which at morn there might be seen several thousands, shall in the evening present not a single one. In the seasons of drought, when the pools dry up in the karroos, when the pasturage is burnt with excessive heat, and the very green blade or leaf is withered, then do the Springboks, in myriads, retire from the scene of barrenness, and invade the fertile districts, over which they pass, swarm after swarm, like a destroying army, ruining the corn-lands and pasture-grounds of the grazier, and leaving a broad track of desolation to mark their line of march. The beasts of prey, the assagais of the natives, and the guns of the colonists, are incessantly at work upon them, but do not seem to thin their countless numbers. "The cry is still they come;" and the *trek-bokken*, as the Dutch call these migratory swarms, seems like an exhaustless sea, rolling up, wave after wave, to destroy and overwhelm the land. Mr. Pringle once passed through such an inundation of Springboks, near the Little Fish River; he could not profess to estimate their numbers, but there must have been five-and-twenty or thirty thousand in sight at once—they whitened, or rather speckled the plain, as far as the eye could see. Their general colour is a light cinnamon-red, with a band of deep reddish-brown passing along the sides, and edging the pure white of the under-surface. On the croup is a patch of long white hairs, enclosed by a fold of skin on either side, so as to look like a narrow white stripe, when the animal is quiet; but when it leaps up, these folds come widely apart, and the hairs spread out so as to cover the whole of the haunch, producing a very striking effect. We shall make bold to quote another graphic picture, painted by Cumming, and exhibiting some of the peculiarities of this lovely creature.

"The Springbok is so termed by the colonists, on account of its peculiar habit of springing, or taking extraordinary bounds, rising to an incredible height in the air, when pursued. The extraordinary manner in which they are capable of springing, is best seen when they are chased

by a dog. On these occasions, away start the herd, with a succession of strange perpendicular bounds, rising with curved loins high into the air, and at the same time elevating the snowy folds of long white hair on their haunches, and along the back, which imparts to them a peculiar fairy-like appearance, different from any other animal. They bound to the height of ten or twelve feet, with the elasticity of an India-rubber ball, clearing at each spring from twelve to fifteen feet of ground, without, apparently, the slightest exertion. In performing this spring, they appear for an instant as if suspended in the air, when down come all four feet together, and, striking the plain, away they soar again, as if about to take flight. The herd only adopt this motion for a few hundred yards, when they subside into a light elastic trot, arching their graceful necks, and lowering their noses to the ground, as if in sporting mood: presently pulling up, they face about, and reconnoitre the object of their alarm. In crossing any path or wagon road, on which men have lately trod, the Springbok invariably clears it by a single bound; and when a herd of perhaps many thousands have to cross a track of this sort, it is extremely beautiful to see how each antelope performs the surprising feat, so suspicious are they of the ground on which the enemy, man, has trodden. They bound in a similar manner when passing to the leeward of a lion, or any other animal of which they entertain an instinctive dread."

THE BLUE-BACK.

The animal here pictured stands about three and a half feet high at the shoulder; it carries a most formidable pair of horns, which it is not slow to use when attacked; they are round, uniformly curved backward, and ringed to within about six inches of the points, where they become smooth. Once common in the Cape colony, the blauwbocks are never seen there now; they have been driven beyond the Orange River, where they may be found feeding on the wide open plains, in pairs, or family groups of five or six; they are bold and fierce, turning, when wounded, upon the hunter and dogs with great resolution.

THE GIRAFFE, OR CAMELEOPARD.

We have here a portrait of the tallest and most stately of all the South African animals,—the Giraffe, or Cameleopard,—which naturalists call *Camelopardalis Giraffa*, and which has hitherto been found only in Africa. Of this extraordinary animal the very existence was doubted until up to quite a recent date. Travellers brought home accounts of a creature with a short body and immensely long legs and neck, which could browse on the upper branches of the loftiest trees, and run as swiftly as an antelope; with a beautiful glossy skin, spotted like that of the leopard, and a small, deer-like head, gracefully set upon a long, slender neck; gentle in its demeanour, and harmless in its habits; roaming in small herds amid the forests; stooping, with fore-legs set wide apart, to crop the herbage of the plains, or to drink of the waters of the fountain in the rocky kloof, or glen; having a tongue capable of great elongation, which is at once a grasper, a feeler, and an organ of taste, and which, though it possessed not the strength or flexibility of the elephant's proboscis, performed nearly all the same offices; with short, knobbed horns, and large, lustrous, prominent eyes, so situated that the animal could, without moving its head, sweep the whole circle of the horizon, and detect a foe approaching, from whatever quarter. This account was for a long time set down as a traveller's story, and the giraffe as a fabulous animal; but now we know that it is all true, for have we not seen the gentle and stately creature, "the observed of all observers," lifting its tall head above the enclosure in our public gardens?—have we not admired the graceful symmetry of its colossal proportions, and pictured to ourselves the majesty of its appearance as it roamed in herds amid the wild wide forests and far-stretching karroos. of its own torrid land?

It was about twenty years ago that the Zoological Society first introduced this rare and noble animal to the English public, having procured four from the wilds of Abyssinia. Since then many more have been brought into the country, and we have been somewhat accustomed to the grand and beautiful spectacle which their living and moving forms present. We see them traversing with slow and stately steps from side to side of their enclosure, and bending their lithe necks as though in acknowledgment of the admiration which they excite; turning, the while, their large, lustrous eyes full upon their admirers, with an air of confidence and gentleness which is extremely winning: and we ask, can these be the animals which Cumming so ruthlessly slaughtered?—these, the gentle, harmless creatures on whose death-agonies he so often looked with the same fierce exultation as he would upon those of some savage beast, to slay which was to deliver man from a pest and a destroyer? We can understand, although we can scarcely sympathise with, the feelings of excitement which must possess the hunter at the sight of such noble game; and we wonder not that he should desire to obtain and bear away the skin and other trophies of so magnificent an animal, the more especially as its flesh was serviceable as food; but it irks us much to read of the wholesale destruction which ensued among the herds of cameleopards when Cumming reached that wide, ocean-like expanse of grey forests of cameeldorn and other trees which cover the grassy, undulating country contiguous to the south-eastern border of the great Kalahari desert, and stretching away north to the distant blue hills of Sekhome's land, and east in one level, unbroken plain to the far horizon. Here it was that our hunter first saw what he describes as "a sight the most astounding that a sportsman's eye could encounter." Before him stood ten of these colossal creatures, the majority of which were from seventeen to eighteen feet high; but, beholding him, they at once made off, twisting their long tails over their backs with a loud twitching noise, and cantering along at an easy pace, which, however, obliged him to put his best horse to his full speed to keep up with them. He selects the finest cow from the herd, and after much hard riding, and firing several balls into her, finally brings her to a stand. Dismounting, he "gazes in wonder at her extreme beauty, while her soft dark eye, with its silky fringe, looks down imploringly at him, and he really feels a pang of sorrow, in his moment of triumph, for the blood he is shedding; but his sporting feeling prevails, and pointing his rifle towards the skies, he sends a bullet through her neck. On receiving this, she rears high on her hind legs, and falls backward with a heavy crash, making the earth shake around her: a thick stream of dark blood spouts from the wound; her colossal limbs quiver for a moment, and she expires."

THE ILLUSTRATED BOYS' OWN TREASURY OF

RURAL AFFAIRS AND DOMESTICATED ANIMALS

PLOUGHING.

THAT the plough is an instrument of the highest antiquity is apparent, both from the oldest writings that we possess and from the existing

monuments of Egypt. The oldest forms of the plough of which we have any description in ancient authors, or which are represented on monuments or coins, are very simple: a mere wedge, with a crooked handle to guide it, and a short beam by which it was drawn, form the whole instrument. The light Hindoo plough, now in use in many parts of India, seems to differ little from the old model.

The different essential parts of a plough have certain names usually given to them. The *Body* of a plough is that part to which all the other parts are attached. The bottom of it is called the *Sole* or *Slade*, to the fore part of which is affixed the *Point* or *Share;* the hind part of the sole is called the *Heel.* The *Beam*, which advances forward from the body, serves to keep the plough in its proper direction, and to the end of it are attached the oxen or horses, which are employed to draw it. Fixed in the beam, in a vertical position, before the point of the share, with its point a little forward, is the *Coulter*, which serves to cut a vertical section in the ground, while the point of the share, expanding into a *Fin*, separates a slice by a horizontal cut from the subsoil or solid ground under it. The *Mould-Board*, or *Turn-Furrow*, is placed obliquely behind the fin, to the right or left, in order to push aside or turn over the slice of earth which the coulter and share have cut off: it thus leaves a regular furrow wherever the plough has passed, which furrow is intended to be filled up by the slice cut off from the land by the side of it, when the plough returns. The *Stilts*, or handles, of which there may be either one or two, as is thought more convenient, direct the plough by keeping it in the line required and at a regular depth in the ground. The single stilt appears to be the most ancient form.

Wheels are a modern invention in comparison with the other parts. They support the end of the beam, and prevent it from going too deep into the ground or rising out of it while the plough is going on. The greatest improvements introduced into modern ploughs are in the shape of the mould-board, or turn-furrow, and the contrivances for regulating the line of draught, so as to make the plough go at an equal depth, and cut off a regular slice of equal breadth, without any great force being applied by the ploughman who holds the stilts.

The following extracts from an interesting little work published by Houlston and Stoneman, entitled the "Ploughman," will afford some useful information to those of our readers who are unacquainted with the various processes in which this valuable implement is employed:

"You will have observed," said Mr. Lightfoot, an experienced farmer, to his pupil Robert, "that some fields are ploughed up in a different manner from others, and the lands or ridges formed differently—some being very narrow, others of a considerable breadth, and a difference is also made (between the light soils and the heavy ones) in the shapes of the ridges, the wet soils being thrown up into ridges with somewhat higher crowns than the drier ones." Robert immediately mentioned the name of a field where the soil was clayey and heavy, where he had noticed the ridges as being higher in the crown or centre than those in the adjoining field, but he had supposed it had proceeded from some whim or mismanagement of the parties that had last ploughed it, rather than from any design or intention. Mr. Lightfoot then went on to inform him, that although some farmers at the present day throw up their wet soil in ridges with very elevated crowns, particularly where it is intended they should continue under grass for several years, the practice was by no means so common as it formerly used to be. "But this is not," continued he, "the point to which I proposed principally to draw your attention, for I wished to say a few words upon the *three* most ordinary modes of ploughing, or, it might be said, upon the three heads into which ploughing is commonly divided; which, among agriculturists, are known by the terms *casting*, *cleaving*, and *gathering*. Now the ridges you are here engaged upon are thrown up in three-bout ones, in order that the soil might be more exposed to the action of the weather, than if they had been ploughed in wider lands or ridges. One-bout or two-bout *ribs* would have answered quite as well or better, but in that case the surface would have required to be levelled before the new seed ridges could have been formed. Now, although you have been ploughing these lands after the manner called *cleaving*,—for you have cleft the original ridges, and so formed new ones of precisely the same size; you, probably, by collecting two halves into a new ridge, conceived that you were ploughing in the manner known by the term *gathering;* but even admitting this were the case, you are aware that you never saw corn growing upon my farm upon such narrow ridges as you are making, except in the far spring-field, or the clayey pasture. My intention was to gather two of the original ridges into one, and nothing could have been easier, for by commencing in the first furrow from the fence, and ploughing each of the old ridges into that furrow, both ways, a new ridge would then be formed of double the size of the old ones, having its crown exactly in the place of the furrow into which the soil was turned by the plough in the first bout. There being an old furrow on either side of the ridge, care should be taken to raise a little new soil in these respective furrows—that is, at the last bout that finishes the new ridge,—a portion of which, when the harrows pass along, will be forced back into the furrows between the newly-formed ridges, which, otherwise would be wider than necessary." Robert at once saw the plan he ought to have adopted, and, had he taken the time to *think*, he probably would have got right without any specific instructions; for although he had gone on for a few ridges, he had felt by no means satisfied that he was doing his work properly, and when Mr. Lightfoot appeared in sight he was glad that an opportunity of being better informed upon the subject was afforded him.

"There appeared no other means of rectifying the mistake than by re-ploughing the few lands he had already completed; but as he had an odd half-land, where he left off, he did not at once see how it was to be managed. But Mr. Lightfoot pointed out to him the fact of his also having thrown out, towards the fence where he had commenced, another odd half-land; so by beginning again at the outside, and gathering that and half of the next ridge together, and proceeding in this way until he had re-ploughed the few ridges, he would find both the original ridges and furrows exactly in the places they ought to have been, and no odd half ridges in any part of the work. Robert soon comprehended this part of the business, and when he was about to re-commence, his master told him to delay a few minutes, as he wished to say a few words upon the other heads of ploughing.

"Although it is the custom among ploughmen in many parts of the country to call the plan that Robert was directed to pursue *gathering*, and with some appearance of propriety—for two ridges had to be collected into one—yet among agriculturists "gathering" signifies quite a different mode of proceeding; and, as Mr. Lightfoot informed Robert, the mode he had to pursue is called *casting*, that is, casting two lands into one. But this term is also applied to ploughing ridges in pairs, and keeping the original crowns, and furrows too, in the situations they previously occupied; "but," continued the master, "you never see this plan adopted by my men, and it is rarely practised upon arable farms, where the soil is scarcely ever allowed to remain over two years undisturbed. Neither is the plan now much practised, which was anciently called gathering, and which is performed by beginning in the centre of the ridge, and ploughing it *inwards*, both ways, thus raising the crown higher by a new addition of soil, and making the old furrows deeper by taking some more soil out of them. I have seen, in my youth (said the farmer) fields that have been ploughed in this way from time immemorial, and never in any other; and the consequence was (the ridges being twelve or fifteen feet wide), that the crowns of the ridges were probably two feet higher than the level of the furrows, which had become large trenches.

APPLE GATHERING.

The most useful fruit that this country affords, the apple, successively ripens, according to its several varieties, from July to October; but the principal harvest of them is about the close of September. They are now gathered for our English vintage. Cyder-making, in some counties, and particularly Worcestershire, Somersetshire, and Devonshire, is a

busy and important employment; but, like the hop, it is so precarious a produce, as to render it unwise for the cultivator to place his chief dependence on it.

The apples, after being carefully gathered, are laid awhile to mellow, and then crushed in a mill and pressed till all their juice is extracted.

This, after being fermented, becomes cyder, which may properly be called apple-wine. Pears treated in the same manner yield a vinous liquor called perry. The richest and strongest kinds are distributed for sale over the whole country, and the inferior sorts serve as common drink in the districts where they are produced.

Autumn paints
Ausonian hills with grapes, whilst English plains
Blush with pomaceous harvests, breathing sweets.
O, let me now, when the kind early dew
Unlocks th' embosom'd odours, walk among
The well ranged files of trees, whose full aged store
Diffuse ambrosial steams.
Now, now's the time; ere hasty suns forbid
To work, disburthen thou thy sapless wood
Of its rich progeny: the turgid fruit
Abounds with mellow liquor. PHILIPS.

REAPING.

Pour'd from the villages, a numerous train
Now spreads o'er all the fields. In form'd array
The reapers move, nor shrink for heat or toil,
By emulation urged. Others dispersed
Or bind in sheaves, or load or guide the wain
That tinkles as it passes. Far behind
Old age and infancy with careful hand
Pick up each straggling ear.

THIS interesting scene is beheld in full perfection only in the open-field countries, where the sight can at once take in an uninterrupted extent of land waving with corn, and a multitude of people engaged in the various parts of the labour. There is no prospect more generally pleasing than this, and which affords a more striking example of the effect of associated sentiments, in converting into a most delightful view that which, in itself considered, is certainly far inferior in variety and beauty to what is daily passed by with indifference, or even disgust.

The gathering in of the harvest is a scene that addresses itself not so much to the eye as the heart, and the emotions that it gives birth to are not so much those of delight and surprise, as the satisfactory termination of anxiety, and, in consequence, benevolence to man and gratitude to the Being who fills our stores with plenty, and our minds with gladness;

> Be not too narrow, husbandman! but fling,
> From the full sheaf, with charitable stealth,
> The liberal handful. Think, oh! grateful think,
> How good the God of harvest is to you,
> Who pours abundance o'er your flowing fields.
>
> THOMSON.

In a late season, or where favourable opportunities of getting in the harvest have been neglected, the corn itself suffers greatly from heavy storms of wind and rain. It is beaten down to the ground, the seeds are shed or rotted by moisture; or if the weather continues warm, the corn *grows*, that is, the seeds begin to germinate and put out shoots. Grain in this state is sweet and moist, it soon spoils on keeping; and bread made from it is clammy and unwholesome.

Harvest concludes with the field-peas and beans, which are suffered to become quite dry and hard before they are cut down. The blackness of the bean-pods and stalks is disagreeable to the eye, though the crop is valuable to the farmer. In England they are used as food for cattle only, as the nourishment they afford, though strong, is gross and heavy; but in most of the other European countries they contribute largely to the sustenance of the lower classes.

It was formerly the practice to cut grain with a saw-edged sickle; but this has given place to a larger instrument, with a smooth edge, like a scythe. The reapers are usually divided into bands of six or seven, with a binder to each band. When the ridges are less than eighteen feet broad, three reapers are usually placed upon each ridge, the middle reaper making the bands with which the sheaves are bound up. When four reapers are placed upon one ridge, as is usually the case when the ridge is eighteen feet broad, two bands are laid upon one ridge; and two binders are enabled in this way to manage twelve reapers, placed on three ridges, stooking the corn all in one row upon the middle ridge. When the crop is very strong, however, it is often found necessary that each binder should stook by himself. In harvesting oats and barley, each shock or stook is formed of ten sheaves placed in two rows, the head of each sheaf leaning upon the opposite one, and a sheaf on the top at each end. They stand usually due north and south, so that each side may receive equal benefit from the sun. The straw of wheat being longer than that of oats and barley, the stooks of the former are made larger, having six sheaves in each row, and one on the top at each end. When the crop is thin, half stooks are frequently set up.

The rural festival of *harvest-home* is an extremely natural one, and has been observed in almost all ages and countries. What can more gladden the heart than to see the long-expected products of the year,

which have been the cause of so much anxiety, now safely housed and beyond the reach of injury?

The poor labourer, too, who has toiled in securing another's wealth, justly expects to partake of the happiness. The jovial harvest-supper cheers his heart, and induces him to begin, without murmuring, the preparations for a future harvest.

HOPPING.

THE hop-vine, the *humulus lupulus* of botanists, is a native of Britain, and most parts of Europe. It is diœcious, that is, the male and female flowers grow upon different plants, and are of a different form; the *catkins* are picked and dried for the purpose of brewing. There is only

one species of this plant, but there are several varieties of it, the qualities of which depend much upon the soil. The most extensive plantations are in Kent, Sussex, and Herefordshire; but they are also cultivated in Worcestershire, Wiltshire, Hampshire, Gloucestershire, Surrey, and several other counties. Kent, in particular, is celebrated for the mildness of its hops. Those in the neighbourhood of Canterbury and

Farnham are reckoned of the best quality for porter, uniting an agreeable flavour with strength. Nottingham hops grown on clay, called north clay hops, are strong, but are thought to have a rather rank flavour; they are chiefly fit for liquor that is to be long kept. In Worcestershire and Cheshire, a mild hop is grown, very fit for ale.

The young plants are raised in beds, and may be raised from seed; but it is more usual to plant the young shoots which rise from the bottom of the stems of old plants. The varieties most esteemed are the Grape Hop, the White Vine, and the Golden Hop. The young plants are placed in groups of three each, about six inches asunder, in the midst of prepared masses of soil about a yard asunder. A watering with liquid manure greatly assists their taking root, and they soon begin to show bines. A stick three or four feet long is then stuck in the middle of the three plants, and the bines are tied to this stick with twine or the shreds of Russia mats, till they lay hold and twine round it. During their growth the ground is well hoed and forked up around the roots, and some of the fine mould is thrown around the stems. In favourable seasons a few hops may be picked from these young plants in the autumn, but in general there is nothing the first year. Early in November the ground is carefully dug with the spade, and the earth, being turned towards the plants, is left so all the winter.

In the second year, early in spring, the hillocks around the plants are opened and the roots examined. The last year's shoots are cut off within an inch of the main stem, and all the suckers quite close to it. A pole about twelve feet long is then firmly stuck into the ground near the plants; to this the bines are led and tied as they shoot, till they have taken hold of it. The ground being well hoed and the earth raised round the plants, the produce this year will average 4 cwt. per acre if the season is favourable.

In September the flower containing the seed will be of a fine straw colour, turning to a brown; it is then in perfection. No time should now be lost in picking them.

The poles are an expensive article; those of chesnut are the most durable, and also the dearest. They should be put into a shed during winter; or else be placed on end in the form of a cone, leaning against each other.

Besides the use of hops in brewing, they produce a bitter infusion and a tincture which are valuable in medicine for complaints in the stomach.

Hops are dried nearly in the same manner as malt. They are spread upon a hair cloth, from eight to twelve inches deep, and placed in the kiln, and a steady heat is applied for eight or ten hours, until the ends of the hop stalks are quite shrivelled and dry; they are then taken off, and laid out on a large floor to cool. When quite cold they are packed up in bags, and sent to market. As the smoke from any fuel would be improper in drying hops, some kind that gives none is used, as coke, Welsh stone coal, or culm, or charcoal.

SHEEP WASHING.

One of the earliest rural employments of June is the shearing of sheep, a business of much importance in various parts of the kingdom where wool is one of the most valuable products; and yields much rustic mirth. England has for many ages been celebrated for its breeds of sheep, which yield wool of various qualities, suited to different branches of the woollen manufacture.

The time for the operation of shearing will vary much with the state of the animal and of the season. After a cold winter, and the animal having been neglected, the sheep will be ready at an early period, for the old coat will be loosened and easily removed. The operation should never be commenced until the old wool has separated from the skin, and the new coat of wool is sprouting up. The coldness or warmth of the spring will also make a great difference. The usual time for shearing is about the middle of June, and the sheep-master will in a moment perceive when the fitting time is come.

Custom has very properly required that the old fleece shall be cleansed before its removal, by washing the animal in some running stream. Two or three days are then allowed for the drying of the wool previous to its being shorn, the sheep being turned into a clean rick-yard, or field, or

dry pasture, and remaining there until the fleece is dried, and in order that the new yolk, which is rapidly secreted, may penetrate through it, giving it a little additional weight and a peculiar softness.

DOMESTICATED ANIMALS.

THE HORSE.

Troops of wild horses abound in various parts of Asia and Africa, ranging over vast plains, and frequenting those wooded districts, where at one time umbrageous and lofty trees nearly shut out the light of day, whilst at another, wide and open spaces are covered with the finest herbage. Each troop is headed by a leader, who acts, as it seems, with despotic power. When danger threatens, he is the first to face the enemy; and travellers who have witnessed their rencontres with wild animals, relate that the chief evidently gives directions with regard to

ARAB AND HORSE.

the necessary arrangements; that he gallops round the troops, and that if any straggle from the ranks, or lag behind, he gives them a slight kick or push, and obliges them to retake their places. Conscious, apparently, that strength consists in union, the approach of a ferocious animal causes a complete consolidation of forces; those who were grazing at a distance immediately join their leader, and fall into the ranks in as orderly a manner as well-trained cavalry.

The editors of Cuvier's "Animal Kingdom," have spoken much at large concerning the habits and instincts of wild horses; we owe to them the knowledge of the curious fact that each chief is indebted for his elevation to his prowess, and that he generally retains his office for about five years. Should any accident befall him, or if he no longer heads his troop with equal fire and activity, a stronger animal seeks to take his place; if, however, he effectually resists the attack, the usurper falls back into the common herd; but if vanquished, he never endeavours to reinstate himself.

"Order is Heaven's first law," and doubtless it is the design of their Creator, that animals should exhibit the advantages of rule and of obedience. Queens preside over communities of happy and industrious bees; wild oxen have their leaders; sheep also, and those vast herds of deer which migrate from the northern regions in quest of fresh pastures, are uniformly conducted by one of their own company, in whom both strength and sagacity are combined. Horses in like manner are under the control of a powerful and experienced chieftain; were it otherwise, they would continually fall victims to the larger felinæ, such as lions and tigers, panthers and leopards; but these they either keep at bay with tremendous kicks, or else escape, by means of their great celerity.

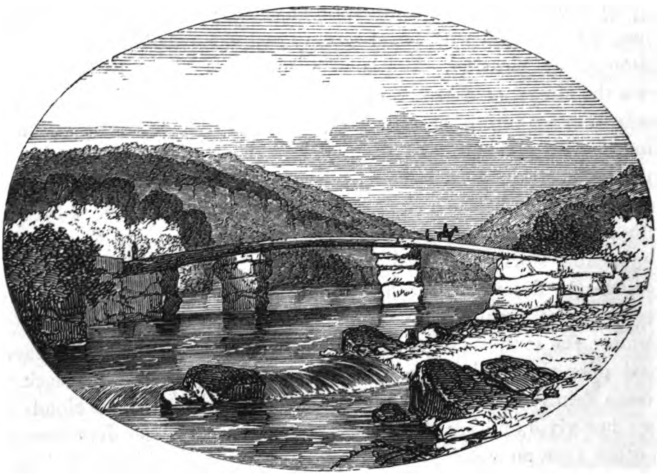
And yet, though terrible to their enemies, wild horses are by no means formidable neighbours. Unlike the carnivora, they never prey upon defenceless creatures, they pasture on grass and vegetables, on the buds and bark of trees, quenching their thirst in running streams, and it rarely happens that any disputes arise among them; they congregate apparently together for advantages that result from union, and neither quarrel among themselves nor seek to injure lesser animals. Mothers who have colts never range to any distance from the rest; and if a thoughtless young creature wilfully gallops off, he is presently brought back. The least injury offered to a colt or its mother would infuriate the whole company; the terrified or suffering creatures would be immediately encompassed by friends able to protect or to revenge them; if the assailant was too formidable to be attacked in the open field, strong hoofs would deal destruction if he dared to approach; but if unable either to defend himself, or to escape, he would be trampled to death.

We owe to the enterprising traveller, Dr. James, much interesting information relative to those vast troops that abound in the prairies southward of La Plata, and on the plains of the Mississippi, descended most probably from such domesticated animals as the Spaniards brough with them. He tells us that their graceful movements and rapid evolutions equally delighted and astonished him; that he has seen hundreds of them in those beautiful solitudes, wheeling nimbly, and frolicking in sportive circles, or chasing one the other over immense plains bounded only by the horizon. But when broad hills, gently swelled in the distance, intermingled with forest scenery and rich pasturage, the effect was indescribably pleasing. Herds of wild horses might be seen rushing down the steeps, or ascending them, with equal celerity; their graceful heads in every variety of attitude, now proudly tossed as if with a consciousness of strength and dignity, now bent downwards, while every muscle was strained in some friendly race. On one occasion, when the travellers halted beside a sheltering rock, because the heavens grew dark with clouds, and the rumbling of distant thunders gave notice of an approaching storm, they witnessed a scene that may well detain us a few moments to describe. Strange sounds came remotely on the ear, they resembled the rushing of headlong waters, as if a river had broken its bounds; the sounds came nearer, and then the trampling of innumerable hoofs upon the hard soil was distinctly heard; presently a dark mass became faintly visible, for evening had drawn in, and the clouds hung low; but vivid and successive flashes soon revealed the dark mass to be no other than an aggregate of frightened horses, rushing with headlong fury towards the rocks. Happily the narrator and his companions had pitched their tents close beside them. Yet the troop, with manes and tails flying in the gale, passed so near, that many a stout heart quailed at the moment, for the rush was terrible. A few moments more, and the whole company had swept by; their receding hoofs waking up innumerable echoes among the rocky labyrinths, till it seemed as if the sounds would never die away.

Horses, when domesticated, are equally intelligent and docile; they readily attach themselves to their masters; and who among the numerous visitors of the Crystal Palace can forget the fine group of statuary that represented a lady discovering the dead body of her husband? The warrior lies extended on the battle-field, and beside him stands his noble war-horse, alone in his sorrow, for none who draw breath are near.

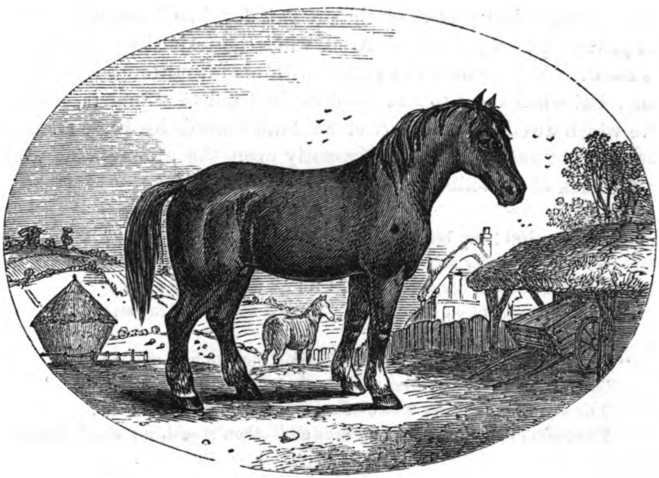
Very many anecdotes have been related concerning the attachment of the horse. We remember the following as particularly applicable to our subject; it occurred not long since, and the high character of the narrator places its authenticity beyond all doubt.

Several Arabs were taken prisoners during a deadly contest between two hostile tribes, and were speedily conveyed, with their horses, to a distant encampment on the trackless desert. One of the prisoners, named Abdallah, was exceedingly attached to the faithful steed who had borne



BRIDGE OVER THE DART.

him safely amid many perils; not that his attachment was, perhaps, greater than is general among the descendants of Ishmael, but some early and, it may be, undefined association, seemed to bind him closely to his favourite, and he resolved, if possible, to set him free. He thought within himself, "If I cannot see again my wife and children, at least this poor creature shall give them some idea of my fate;" and thus thinking he crawled from the place where he was lying severely wounded, towards the spot where several horses were tied to stakes stuck in the ground. It was then night; he dared not speak a word, lest the slightest whisper should reach the ears of his Arab captors; but though necessarily cautious, the faithful animal was not slow in recognising him. He stamped impatiently, and expressed his pleasure by a low sound of congratulation; on hearing which Abdallah caught hold of the cord by which the steed was fastened, and began gnawing it with his teeth, till having severed it, he thus addressed him—"Go, my faithful servant, hasten to our tent; you know the way, for we traversed it together when your poor master was taken prisoner; go to my wife and children; go to my brethren, and tell them, as best you may, that I am still in the hands of strangers." It seemed as if the steed understood the captive condition of his master, for, instead of bounding forth, he stooped towards the



ENGLISH CART-HORSE.

ground, and catching Abdallah by the girdle that confined his waist, he threw him across his back and galloped off with incredible rapidity. The trampling of his hoofs on the hard sand awoke the hostile tribe; they started as one man, and were presently on horseback with spears in hand; each rider urged his courser across the desert, following the flying footsteps of the Arab steed, but all in vain. Abdallah's horse was renowned for his fleetness, and he presently distanced the company of pursuers, while his master regained his right position. Away then they went, that horse and man, scouring along the waste and desolate wilderness, till at length, and when the day had scarcely dawned, tents were seen in the distance, and Abdallah recognised them as belonging to his tribe. Then there was rushing forth, and joyous exclamations, women who clapped their hands wildly, and wept for joy; little children who clasped the knees of their parent, and eager men who hurried from their tents upon hearing the trampling of horse's hoofs at such an unwonted hour. But how fared it with the faithful horse, who stood in their midst while his wounded master was helped to alight? He looked on the familiar faces, but only for a moment, and then fell dead from extreme fatigue.

A distinguished poetess of the present day has beautifully embodied the grief of an impoverished Arab, when constrained by poverty to sell his steed. The poor man had parted with his favourite for a considerable sum; but when about to leave him in the hand of strangers, the strong love which dwells in the heart of an Arab towards his horse resumed its power; he flung the gold indignantly upon the ground, aud vaulting on the back of the animal, was presently out of sight.

"My beautiful! my beautiful! that standeth meekly by,
With thy proudly arch'd and glossy neck, and dark and fiery eye,
Fret not to roam the desert now, with all thy winged speed,
I may not mount on thee again. Thou'rt sold, my Arab steed!

"Fret not with that impatient hoof; snuff not the breezy wind;
The further that thou fliest now, so far am I behind.
The stranger hath thy bridle-rein—thy master hath his gold;
Fleet-limb'd, and beautiful! Farewell!—thou'rt sold, my steed, thou'rt sold!

"Farewell! those free untired limbs full many a mile must roam,
To reach the chill and wintry sky which clouds the stranger's home;
Some other hand, less fond, must now thy corn and bed prepare;
The silky mane I braided once, must be another's care!

"Yes, thou must go! the wild free breeze, the brilliant sun and sky,
Thy master's home—from all of these, my exiled one must fly.
Thy proud dark eye will grow less proud, thy steps become less fleet,
And vainly shalt thou arch thy neck, thy master's hand to meet.

"Will they ill use thee? If I thought—but no; it cannot be—
Thou art so swift, so easy curb'd; so gentle, yet so free;
And yet, if haply, when thou'rt gone, my lonely heart should yearn,
Can the hand which casts thee from it now, command thee to return?

"Slow and unmounted will I roam, with weary step alone,
Where with fleet step and joyous bound, thou oft hast borne me on;
And sitting down by some green well, I'll pause and sadly think,
'T was here he bow'd his glossy neck, when last I saw him drink.

"When last I saw thee drink!—Away, the fever'd dream is o'er,
I could not live a day and know that we should meet no more.
They tempted me, my beautiful! for hunger's power is strong,
They tempted me, my beautiful! But I have loved too long.

"Who said that I had given thee up? Who said that thou wast sold?
'T is false, 't is false, my Arab steed! I fling them back their gold!
Thus, thus, I leap upon thy back, and scour the distant plains;
Away, who overtakes us now, shall claim thee for his pains."

Neither history nor tradition, conjectures nor records the period, when horses were rendered in this country subservient to purposes of husbandry or warfare. Cæsar wrote concerning the terrible war-chariots of British soldiers, about fifty-nine years before the Christian era; and still on Dartmoor, the Highlands of Devonshire, a primitive bridge remains, over which the scythed chariots of Damnonian warriors passed and repassed.

This bridge has withstood the fury of the Dart, when swollen by storms of rain, and lashed into fury by fierce winds, for twenty or thirty centuries. The piers consist of six layers of granite slabs laid upon a strong foundation; the stones which serve to form the bridge are about fifteen feet long and six wide, and thus a ready communication was opened from one portion of that rocky region to another.

Horses were most probably first brought from Gaul to Britain, and were chosen by our uncivilized ancestors for their agility and strength. Since then a great variety have resulted from domestication; and among these the English racer and plough or cart-horse present two opposite extremes, both as regards their usefulness and exterior—the one, invaluable to mankind, and often a source of wealth; the other, so frequently a cause of ruin to many a noble family. Four more principal races may likewise be enumerated—the hunter, the carriage-horse, the lady's palfrey, and the old English road-horse, a strong, vigorous, and active creature, capable of enduring great hardships, though in height seldom exceeding fourteen hands.

Pack-horses were employed, in old times, to carry different manufactures and articles of traffic from one part of the country to another. While journeying over trackless moors, they strictly adhered to the order and regularity which custom had taught them to observe. The leading horse, who was uniformly selected for his sagacity and steadiness, and around whose neck were suspended a number of jingling bells, headed the procession, and went onward with grave and measured steps, as if conscious that his office was one of confidence and responsibility—and, without doubt, the animal felt no small complacency in being thus distinguished by his master. Bewick tells us, that a leading horse who had, for many years headed a considerable number of pack-horses, had been accidentally placed among them in starting. The poor creature, deeply affected by the unintentional degradation, made the most strenuous exertions to recover his place; he pushed before those who preceded him, and, with some difficulty, kept them back till having taken the lead as usual, he maintained it during the remainder of a long and toilsome journey. The master saw with satisfaction that his favourite was following as usual; but scarcely had he reached the inn-yard, when the wearied animal sunk down and expired.

The jingling of those bells is not now heard, but we remember an old man who told concerning long lines of pack-horses that passed, in his young days, across a rapid stream, and wound wearily up a steep ascent, near our native village.

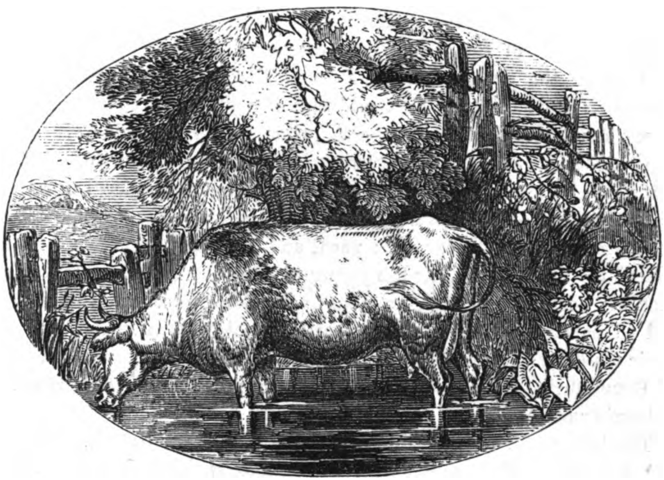
Learn, my friends, to regard the domesticated species that minister to your wants, as especial gifts from God to man. You will then appreciate the blessings which they confer, and treat them with lenity and consideration.

OXEN.

Why is it that when birds and their associations charm all readers and incline them to regard with heightened interest the feathered denizens of our woods and rocks, our wild sea cliffs, our meadows, and furze-clad commons, that no one has taken thought concerning the animals of Britain?

Look abroad into the beauteous solitudes of Nature, and see how many rejoicing creatures bound merrily on the dewy grass; look into the fields and along the roads, mindful of those who bow their necks to the yoke of man, or minister to his necessities, and tell me if you know all that that may be known respecting them.

Methinks I hear some one say—"What handsome cows are grazing in yonder meadow," and, perhaps, another rejoins—"I am glad the hedge is between us." The first speaker merely regarding them with reference to the effect which they produce in landscape scenery; the second, thinking only of personal safety. And yet the creature which is suggestive of such different thoughts is invested with associations of deep interest, and such as pertain to the history of our race. Let us not slightly pass



them by, but rather amuse a passing hour with waking up the memories of years long since departed.

The often repeated adventures of Guy, Earl of Warwick, with that terrific animal, whose depredations are equally recorded in legends and in song, go far to prove that even in this country the fearful outbreaks of the formidable creature were such as called forth the prowess of ancient heroes, and iuduced Philip of Macedon to hunt his quarry about Mount Obela. But the adventures of which we speak were not peculiar to the Earl of Warwick. Fitzstephen, who lived in the reign of Henry I., spoke concerning a savage animal, the Urus Silvestris, which infested the wild and extensive forests that spread wide and far in the neighbourhood of London. "The forests," quoth he, "were vast, nay, almost pathless, in some parts well watered with running streams, and having open spaces that produced abundance of bright flowers, but whether open or thickly shaded, no one dared to venture there alone, and without being well armed, on account of outlaws, and desperate cattle, which it is hard to daunt." The Scottish forests were infested in like manner; and the family of Turnbull derived their name from the fact of one of their ancestors having turned a wild bull from King Robert Bruce, when, rushing out of a thicket, he made a furious thrust at that monarch. This is presumed to have occurred early in the fourteenth century.

Descendants of the "desperate cattle," mentioned by Fitzstephen, still range the Scottish hills. Boetius also speaks of them under the name of Tubati Bisontes, as a wild race of white oxen, that were equally fierce and untractable. Time was, when immense herds were seen in the vast forests of that country, as well as in those of northern Europe; but neither history nor tradition records the era when a few submitted to domestication, and others were destroyed. Most probably, some deserted foundling, taken to a farmer's yard, and carefully nurtured, first suggested the idea of bringing the young of such aboriginal animals to subjection; certain it is, that, previous to the Reformation, large herds were fed in parts belonging to ecclesiastical establishments, and that after their dissolution, vast numbers were transferred to the wooded territories of Drumlanrig, with other tracts of equal extent and sylvan character, belonging to Scottish chiefs.

The habits of such as still remain in a wild state differ from those of the domestic species, and probably assimilate with the peculiar characteristics of their savage ancestors. If a stranger appears in their vicinity, they immediately cease grazing, or else start wildly up, if lying still, and gallop in a circle round him; then stop to graze, tossing their heads, and showing signs of defiance; another moment, and they again wheel round, with menacing looks, and he who thus becomes an object of dislike, will do well to effect an immediate retreat. Dr. Fuller tells us, that when passing through a lonely district in the Scottish Highlands, he came unexpectedly upon one of those white oxen, apparently only two days old; the young creature was extremely weak, and scarcely able to support its slender frame; yet it rose immediately on being stroked, and began to paw the ground, bellowing at the same time with all ts might, and after retiring backward for a few paces, again came forward, and struck at the narrator's legs; but, missing its aim, through weakness, it fell upon the ground, and was unable to rise. Presently, however, was heard an answering roar, and a tremendous rush among the distant underwood, and onward with incredible celerity came the affrighted mother, accompanied by the herd, to its relief. Flight was impossible, and Dr. Fuller did not attempt it. He merely retired to a short distance, without betraying any symptoms of fear, and being armed with a strong oak cudgel, none of the excited creatures seemed inclined to attack him.

Domestic oxen are widely diffused throughout the ancient continents, reclaimed without doubt from a wild condition. Almost every country has its peculiar breed—Madagascar and Caffraria, Abyssinia and Tuscany, Hungary and the Roman States, European Turkey, Calmuc Tartary, and the Ukraine. The Caffres and Hottentots rear a fine kind, of extraordinary size and remarkable intelligence. They readily submit to all kinds of domestic labour; nay, they are so tractable, as to be managed, if possible, with more ease than horses; the voice or whistle of their master suffices to direct their course, and, in return, for their docility, they become rather the friends than the servants of the native farmers. How widely different, as I once observed elsewhere, is their condition from that of many poor oxen, in their own country, who have frequently much to endure from their owners. If we understood our true interest and happiness, we should treat our four-footed dependents with kindness and consideration, assured that the goad, or blows, or neglect, only render them self-willed and stupid. Men, whom the enlightened Englishman is pleased to regard as far inferior to himself, entertain, in many instances, a more correct judgment respecting the rights of the animal creation. The Hottentot loves his ox, and the Arab his horse, and these domesticated creatures, in return, co-operate cheerfully with their masters, whether ploughing the stubborn soil or scouring the vast and burning desert. By such reciprocity of kindly offices, each animal increases in docility and intelligence; he becomes more affectionate and confiding; he yields to gratitude and love, what, in this country, is too frequently the consequence of fear.

Hottentots train their oxen for warlike purposes, and employ them nearly in the same manner as the Indians do their elephants. They are called backleys, from a word, signifying, in their language, war; yet the name thus given them is not altogether just, for the war which they carry on is solely defensive, and has for its object such ferocious animals as attack their master's flocks. Every kraal, or village, has at least six of these well-trained animals, selected from among the fiercest oxen; and if one of the number happens to die, or becomes infirm from age, another is chosen to succeed him. The office of judge in this important matter is assigned to the oldest and most intelligent Hottentot in the kraal, who carefully looks over the herd, and selects the animal which

PLOUGHING IN ANCIENT TIMES.

he most approves. The creature is then placed with an experienced backley, whom he never quits, either by night or day; during the former, they are tied together by the horns; in the latter, they work conjointly, till, at length, the unwieldy pupil adopts the habits of his tutor, and becomes also a vigilant defender of the herd. Travellers relate that war oxen know every one in the kraal, whether men, women, or children, and evince the utmost kindness towards them; that they even allow little toddling creatures to pull their tails, and play with their terrific horns when lying down, or to seat themselves upon their backs;

but woe to any stranger who ventures to approach one of these formidable animals, unless accompanied by a Hottentot.

Observe yonder cow! Many associations are connected with her. She brings to mind the earliest ages of society, when cattle constituted the chief riches of a great man; when Jabal, the son of Adah, had much wealth in flocks and herds, and when Abraham and Lot, in after times, were unable to dwell together, by reason of their cattle. On her rest, also, the memory of those benevolent laws, which restricted the length of a furrow to one hundred and twenty paces, and those equally merciful

OXEN THRESHING CORN.

regulations which enacted that the patient ox should rest a few minutes at the end of each furrow, or before commencing a new one. Suggestive, too, is that quiet, ruminative animal of edicts which equally regulated the labours of the husbandman, and of poets who record his blameless occupations. Hesiod gives it as the character of a good husbandman that he attends to his duties, and looks before him in order to form his furrow aright. Our Lord uses the phrase of one that looks behind him while his hand is on the plough, as proverbially expressive of a careless person, who renders himself through his negligence undeserving the blessedness of eternity—"No man, having put his hand to the plough, and looking back, is fit for the kingdom of heaven."

The ancient plough was light, the labour comparatively easy; but then the very lightness required that the ploughman should lean upon it with his whole weight, or else it would glide over the soil without making a single furrow. "Unless," said Pliny, "the ploughman stoop forward, to press down the plough, as well as to conduct it, truly it will turn aside."

Think you further, when contemplating yonder tenant of the meadow, of the prophet Hosea, who prophesied more than seven hundred years before the Christian era, and carry back your thoughts to the plains of Palestine. "Blessed," said he, "are ye who sow beside all waters, who send forth thither the feet of the ox and the ass." In reference to which Chardin, a celebrated traveller into Persia and the East Indies during the reign of Charles II., observes, that ancient and even modern husbandmen, in those far off regions, uniformly sow rice upon the waters, previous to which, and while the earth is still overflowed, they tread the ground with oxen, who go mid deep, and thus prepare the soil to receive the coming grain.

Have you ever heard that oxen were anciently employed in threshing corn, and that the same custom is still retained in Egypt and the east? This operation is effected by trampling upon the sheaves, and by dragging a clumsy machine, furnished with three rollers that turn on their axles. A wooden chair is attached to the machine, and on this a driver seats himself, urging his oxen backwards and forwards among the sheaves, which have previously been thrown into a heap of about eight feet wide and two in height. The grain thus beaten out, is collected in an open place, and shaken against the wind by an attendant, with a small shovel, or, as it is termed, a winnowing fan, which disperses the chaff and leaves the grain uninjured:—

> "Thus, with autumnal harvests cover'd o'er,
> And thick bestrewn, lies Cere's sacred floor;
> When round and round, with never-wearied pain,
> The trampling steers beat out th' unnumber'd grain."—HOMER.

Horace further tells us, that the threshing floor was mostly a smooth space, surrounded with mud walls, having a barn or garner on one side; occasionally an open field, outside the walls, was selected for this purpose, yet uniformly before the town or city gates. Such was the void place within which the king of Israel, and Jehoshaphat, king of Judah, sat each of them on his throne, clothed in his robes, at the entering in of the gate of Samaria, and all the prophets prophesied before them. In the marginal reading we are informed, that this void space was no other than a threshing floor; and truly the area was well adapted for such an assemblage, being equally suited to accommodate the two kings and their attendants, and to separate them from the populace.

But the ploughshare of our day and those anciently employed in Palestine were widely different. The first is ponderous, and utterly impossible would it be to convert the swords used in modern warfare into purposes of husbandry; but the case is otherwise as regards the second. Eastern ploughshares were of a lighter make, and those who notice the shortness and substance of ancient weapons, among such as are preserved in museums, will understand how readily they might be applied to agricultural uses. Very appropriate, therefore, is the prophetic declaration with reference to these peaceful times that are destined to terminate the funereal train of ages.

Such are the associations which we shall do well to remember, when looking on one of those harmless and valuable creatures that so greatly minister to the wants of man; and, if we were inclined to pursue the subject further, it would be easy to speak of the manufactures which the members of her tribe promote when no longer grazing in meadows or on commons. Their horns furnish glue for the artisan, and various articles for home purposes; their hides, leather; the hair is mixed with lime for plastering; the bones are used as substitutes for ivory, and when calcined are valuable to the refiners of silver; their tallow supplies candles, and from the feet is obtained an oil of great use in preparing and softening leather. We owe to the same animals butter, milk, and cheese; even blood, the gall, and liver have their respective uses, both in manufactures and in medicine.

Widely, therefore, is the Taurine group diffused, and this because their services are everywhere required. They are equally capable of enduring the extremes of heat and of cold, and inhabit alike the frozen and the torrid zones. Bewick, the celebrated engraver on wood and lover of natural history, well observes, that while other animals preserve their distinctive forms and inclinations with surprising exactness, the quiet ruminants of our meadows adapt themselves to the wants and conveniences of mankind. In no other animal, with the exception of the dog and horse, is there so great a variety of kinds, and in none a more humble and confiding disposition.

The climate and pastures of Great Britain are well suited to this valuable quadruped. The first presents a grateful interchange of heat and cold; the second yields an infinite variety of wholesome and nutritious grasses; hence the number and excellence of our cattle, a source of inexhaustible wealth, the pride and boast of this favoured land.

I have used the word ruminating with reference to this animal; the term is appropriately given to such as chew the cud, and a few moments will not be unprofitably spent in briefly describing the means by which such a curious process is effected. Behold, therefore, somewhat of their formation. They are furnished with four stomachs; their food, after being masticated, is received into the first stomach, where it remains some time; after which it is forced up again into the mouth, and undergoes a second chewing; this done, it returns through the first into the second stomach, and gradually passes into the third and fourth, from whence it is received by long, capacious, and variously-folded intestines.

Mercifully designed by their Creator to withdraw mankind from savage and predacious habits, the Taurine group became in after ages objects of especial consideration; some even, forgetful of the Giver, in admiration of his gifts, rendered them objects of idolatrous regard. Thus the Egyptians deified the ox under the name of Apis and Mueris, while the cow was rendered emblematic of maternal nature in the mythologic systems of ancient Greece. The bull holds a conspicuous station among the signs of the zodiac; the same animal typified the sun in more than one idolatrous observance; he became emblematic of irresponsible power among the Greeks and Romans, of strength also in warlike enterprises, and the sinews of commerce in connection with Mercury.

The Editors of Cuvier's celebrated work on Natural History associated much of olden records with oxen, and, to those who are interested in the derivation of words from their origin, it may afford subject for thought and further research to be reminded that the words *Thur*, *Tier*, *Toor*, and *Thur*, in the northern dialects of Europe, signify well-known ruminants; and that a large bovine animal is mentioned in Cæsar's "Commentaries" by the name of Urus, signifying mysterious, fierce and sylvan, ancient and primeval. Hence, also, is the root of names attached to several countries in which the Taurine group of animals still exist.

Thus Turcomania, Thurgau, the Canton of Uri, and Thuringian Forest; Turan of Eastern Persia; Turan, southward of the Caucasian range of mountains, the cradle of the Turkish nation; to which we may add the Taurus Chersonesus, and the Tauri, a Sarmatian tribe, with the Taurini inhabiting Italy, near the present Turin. Throughout this wide range the gigantic Urus of ancient times has left his remains, or the more recent Urus delights to herd.

SHEEP.

The high western basin of Cashmere, encircled with mountains, and abounding in rich pastures; the secondary valleys of Taurus, that great

range of Asiatic mountains which extends far into the torrid zone; the lower portions of Caucasus, abounding with honey, corn, and wine; Caramania, in Asiatic Turkey, and lastly, Angora, with its flowing rivers, may be regarded as the original and most favourite haunts of wool-bearing animals, from whence, it is assumed, that they spread over the habitable globe.

Neither history nor tradition point to the period of their first introduction among our remote ancestors. Probably they were brought over by Phœnician traders; but this much is certain, that many of the British tribes were rich in flocks of sheep and herds of cattle; and still, in many parts of Wales, mountain sheep are found half wild, from the nature of the country. The occupants of our meadows, and such as pasture on village commons, are equally timid and defenceless; but not so the mountain rangers of rocks and heaths. They are no longer seen in flocks, crowding together when alarmed by any unusual sight or sound, as if numbers ensure safety, but ranging fearlessly in small companies. Yet still, mistrustful of some insidious attack upon their liberty, a sentinel may be seen on the look-out from a jutting crag or eminence, and he who passes, however quickly, either beneath the rock or within sight of the careful watcher, no matter how distant, may hear a hissing sound and a rushing of nimble feet, as the wary creatures betake themselves with all speed to their well-known fastnesses, Such are their habits in a partially wild state, among the mountainous parts of Wales, and the same caution and celerity distinguish their transatlantic brethren; hence the difficulty of approaching within gun-shot, described by European travellers, and equally well known to the hunter of Kamtschatka as to the Cree Indian. Nay, it would be impossible to reach them were it not that curiosity, joined to a feeling of security, often prompts the most fearless among the fugitives to stop in their rapid flight, and to look down from some high crag on the men and dogs below. At this moment, guns are fired by practised hunters, who, knowing that sheep are equally inquisitive and cautious, often conceal themselves among ferns and underwood, while their companions raise loud cries in order to attract the notice of their intended victims. Few, perhaps, if any, actually wild sheep are found at the present day, even in the most uncultivated parts of Britain. Yet a wild species once existed, as we learn from Boetius, whose works were translated into the Anglo-Saxon by the illustrious Alfred; that distinguished philosopher and scholar doubtless derived his information from Roman officers who had sailed in various expeditions to this country. We read, too, in ancient records, that a wild species were common to St. Kilda—that they were larger than a goat, with long thick horns and a sweeping tail. Pennant further notices that an animal answering this description is figured in bas-relief on the wall of Antonius, near Glasgow.

The family of Ovis, to which domestic sheep pertain, differ in their wild state not very materially from goats. Naturalists relate that the wool which distinguishes nearly all such as are subject to man, is scarcely more prominent in the wild than in several species of antelope or deer, and even of the wild goat itself. When free to range at will, they select the highest ground, and are consequently often found in the mountainous regions of Asia and of Europe, of Africa and America. Hence their geographical range is of wide extent, and, like their caprine brethren, the goats, they are able to endure a great variety of climate. They are found equally in the islands of the Mediterranean and among the Kuriles of the Northern Pacific Ocean, whither they must have floated on masses of moving ice, which often convey the animals of inhospitable regions from one island to another. It is more than probable that wild sheep might thus have reached the British isles in ancient times.

Different varieties pertain to this interesting family. Russia possesses a hornless race; Astracan a peculiar breed, celebrated for their fine spirally-curled wool; her rich plains, on either side the Wolga, are annually visited by large flocks; for, like the Nile, that river overflows her banks at an appointed period, and when the waters recede, a luxuriant growth of grass almost immediately springs up. Sheep with coarser fleeces, and wattles beneath their chin, perambulate the banks of the same river towards the north; a smaller kind, covered with long coarse vestments, adapted to their rigorous haunts, much resembling hair, yet having warm, thick wool next the skin, affect the mountainous and stony fastnesses of Iceland, beside her jets of boiling mud, and along the sides of the terrific Hecla. When overcome by sudden drifts, whole flocks are sometimes buried beneath the snow for many days; yet still they live on, and such as have owners among the peasantry, are often dug out unharmed.

Africa is said to possess the greatest number of distinct varieties, among which the indigenous, or Hottentot broad-tailed sheep, is especially conspicuous; a numerous family, yet variously modified, and spreading over a vast range of country, extending from Egypt into Russia.

Speak we now of domestic sheep, and among the varieties included under that comprehensive name, the merino is the most important. This race, sub-divided into breeds, extends over the rich plains and pastures of Spain; they are formed into immense flocks of about ten thousand head, with a mayoral, or chief shepherd, having several subordinates, who implicitly follow his directions. Great activity and vigilance, muscular strength, and a complete acquaintance with different kinds of herbage, and likewise with the diseases incident to sheep, are required of the man who fills such an important office. It is also desirable that he should be skilled in such changes of the clouds or winds as the poet of the "Georgics" notices:

"For when the moon appears, if then she shrouds
Her silver crescent in the waning clouds,
She bodes a tempest on the raging main,
Or brews for fields impetuous floods of rain."

The mayoral, or chief shepherd, has a liberal allowance of about seventy-five pounds per annum; he has fifty assistants and the same number of dogs under his control, with the liberty of discharging or selecting them at pleasure; five of each are appointed over a certain number of sheep, and among the items which are entered in his account-book, is an allowance of two pounds of rice daily, for every dog.

The return of migratory birds, and the precision with which certain animals of the groups traverse vast tracts in quest of fresh pasturage, have equally been noticed by natural historians and poets. But the migrations of the woolly race are known to few. Imagine a richly-cultivated or open country, through which immense flocks of two or three thousand sheep are seen quietly progressing, headed by the chief shepherd, and attended by men and dogs. From time immemorial their route has been accurately defined, and the inhabitants are obliged by law to ensure them a free passage through cultivated grounds and vineyards, of at least ninety paces wide. On, on, they go; halting at prescribed resting-places, and frequently beside streams of water, over which umbrageous chesnuts droop their friendly branches.

When journeying through cultivated regions they are obliged to move rapidly, and hence they often pass over an extent of eighteen or twenty miles in the course of the day; but when the plains are to be crossed the case is otherwise; two leagues are thought sufficient, and beautiful it is to see the harmless creatures following their leader, and grazing tranquilly as they move along.

Sheep are by no means stupid animals; their memories especially are well developed; if the head shepherd and his men were to leave a flock to their own guidance, you would see them quietly proceeding to the pastures which they occupied during the previous year. Thus, for example, flocks that are kept in pens during winter, on the plains of Estremadura, no sooner begin to feel the soft breezes and warm sun-gleams of

LARGE-HORNED SHEEP.

April, than they become extremely restless, and their impatient bleatings are heard at a vast distance. Those who like to watch the movements of birds and animals, would look with equal astonishment and delight on the animated scene which is presented when the shepherds begin to pull up the stakes, and loosen the strong ropes which heretofore prevented the escape of their fleecy charge. Dogs stand round with anxious looks and impatient movements, watching lest any of the vast multitude should attempt to break the bounds assigned them, while the men proceed in their work, without having their attention in the least distracted, well knowing that their four-footed colleagues are ever on the alert. At length the head shepherd mounts his horse, men and dogs fall into their respective places, and flocks of two or three thousand sheep cross the

Tagus at Almazas, and proceed to Espinas, Alfaro, and Villa Costen, three shearing places of great extent and ancient renown. When the flocks are divested of their cumbrous vestments, the mayoral again takes the lead, and followed, or attended by their faithful guard of men and dogs, they retrace their steps towards the plains of Leon, and spread over the rich pastures of Cervera, near Aquilos del Campo. Sheep that are fed during winter in sheltered parts of Andalusia and Castile, cross the Tagus in spring, and then proceed to upland pastures, or pass over the clear and flowing Ebro, to range the grassy solitudes of the Pyrenees and of Navarre.

Such is the outline of their annual movements; but a fact is connected with their natural history that may well detain us a few moments to relate. When allowed to pass quietly and to feed as best pleases them, sheep uniformly select the finest herbage, and rarely, if ever, crop a single flower; even the fragrant wild thyme is left untouched; nay, more, it is carefully separated when growing profusely among blades of grass, or else the sheep advances to another spot. Herein is a manifest demonstration of the goodness of the Creator. Spain is equally celebrated for the finest honey as for its wool, and beds of wild thyme form the pasturage of innumerable bees; if, therefore, sheep in grazing were to gather every plant indiscriminately, those industrious insects, which collect the honey harvests from among the flowers, must inevitably perish.

The sister arts of dressing wool, of spinning and of weaving cloth, are derived by our remote ancestors, most probably from Gaul. Some Belgic colonists are presumed to have brought them into Britain, about a century before the era of the Roman invasion, and certain it is, that an imperial manufactory of woollen cloth was established at Winchester, the ancient Venta Belgium.

Flemish weavers accompanied the army of the Roman conqueror, and plied their useful craft with equal benefit to themselves and advantage to the country. Others succeeded them, and in the reigns of Henry I. and Stephen, flourishing manufactures were established in various parts of England; in Gloucester, Nottingham, and Norwich; Bedford and Worcester especially. And so famous were the the Flemings for their skill, that the art of weaving was said to be a peculiar gift bestowed on them by their Creator. But when civil wars desolated the country, men who wrought peacefully at home were constrained to take the sword, and during the disastrous reigns of John and Henry II., the manufacturing of woollen cloths was entirely laid aside. Edward III. sought to revive such a valuable branch of domestic commerce, and history relates, that a small flock of sheep was obtained from Spain by the queen, as a present to her royal husband.

Fuller, with his usual quaintness, speaks of the revival of the woollen manufactory, under the auspices of an enlightened monarch. "Truly, that good king," said he, "resolved, if possible, to bring the trade to his own countrymen, who were yet ignorant of that art, knowing no more what to do with their wool than the sheep that wore it, as to any artificial or curious drapery; their best clothes being no better than friezes, such was their want of skill in their makings. But soon after followed a great alteration, and we shall enlarge ourselves on the manner thereof.

"Unsuspecting emissaries were employed to go into the Netherlands, who wrought themselves into familiarity with such Dutchmen as were absolute masters of their trade, but not masters of themselves, being either journeymen or apprentices. These bemoaned the slavishness of those poor creatures, whom their masters used rather like heathens than Christians; yea, rather like horses than men, early up, and late in bed, and all day having hard work, and harder fare, a few herrings and mouldy cheese, and all to enrich the churls their masters, without any profit to themselves.

"'But, oh! how happy would it be for them,' the emissaries said, 'if they could but come over into England, bringing their mystery with them, which would provide their welcome in all places.' Being thus persuaded, many Dutchmen came over, one from one place, another from another; their coming away made no very great difference, but their meeting together amounted to a considerable fulness.

"Happy the yeoman's house into which one of these Dutchmen did enter, bringing industry and wealth along with them; such as came in strangers soon after went out bridegrooms, and returned sons-in-law, having married the daughters of their landlords, who first entertained them; yea, those yeomen in whose houses they harboured soon became gentlemen, gaining great estates to themselves, and honour to their estates.

"A prime Dutch cloth-maker in Gloucestershire, had the surname of Web given him by King Edward, and during very many years his descendants carried on a flourishing manufactory.

"Now the English wool improved to the highest profit, and went on improving when the cruel Duke of Alva drove more Dutch into England." Fulling mills were then set up, and that most valuable and curious shrub, the teasel, which hitherto had been collected from hedge banks, where, in some parts of England, it grows profusely, was carefully cultivated. These mills were intended to save the expense of fulling or cleansing the cloths from grease, by trampling on them with the feet in running water, as also more conveniently to subject them to the action of the teasel.

Piers Ploughman, a writer of the olden times, contemporary with Edward III., whose "Visions" are well known to the lovers of ancient poetry, thus quaintly speaks concerning the process of making cloth:

"Cloth that cometh from the weving is not comely to wear,
Till it be full'd under foot, or in fulling stocks,
Washen well with water, and with teasels scratched,
Toaked and tented, and under taylour's hand."

Such are a few of the most interesting associations that pertain to the family of Ovis. We could speak of them as connected with rural scenery; as bringing to mind that exquisite pastoral psalm, in which the Shepherd King compares the tranquillity and security of the righteous to a flock of sheep besides a running stream; as recalling, also, the advice of the wise king, who charged his son, "to know the state of his flocks, and to look well to his herds." Hesiod, too, the Bœotian poet, who wrote on agriculture in years long past, and Virgil, prince of Latin poets, sung concerning the fleecy occupants of meadows and sheep walks.

"Pre-eminent among the constellations, and on earth," was a motto chosen by a large wool dealer in Gloucestershire. Truly it was most appropriate: Aries is always welcome when seen on the horizon, herald of lengthening days and sunny gleams. Bloomfield has beautifully described a flock of lambs racing in the meadows:—

"Like the fond dove, from fearful prison freed,
Each seems to say, 'Come, let us try our speed:'
Away they scour: impetuous, ardent, strong,
The green turf trembling as they bound along,
Adown the slope, then up the hillock climb,
Where every mole-hill is a bed of thyme,
Then panting stop; yet scarcely can refrain—
A bird, a leaf, will set them off again."

THE DONKEY.

A CELEBRATED French naturalist, the Abbé de la Pluche, speaks kindly, and yet truly, of the unhasty animal, who feeds quietly beside his master's door, with a pannier filled with children, on his back. The horse and dog, the elephant and camel, are invaluable coadjutors of man, but not less so is the quadruped of which we speak; doubtless he is not endowed with shining qualities, but then he possesses such as are more solid. His voice is not distinguished for melody, nor his movements for grace; neither are his manners peculiarly attractive; but then a fine voice is

DONKEY WITH PANNIERS.—SNOW SCENE.

not essential in his sphere of life; and with him a deficiency in style and manners, is compensated by great stability, and a uniform pace; certainly he is not swift of foot, he goes over the ground somewhat slowly, but though slow, he is exceeding sure; and he will journey on for a long time, without halting to take rest. He performs what he has to do, silently and perseveringly, and without the least assumption, which is, doubtless, no small recommendation in a domestic. Contented with the first thistle that presents itself, and always ready to take up his abode in a shed, however humble, he does not appear to think that his services require any especial remuneration; he rather thankfully accepts whatever is offered him, than claims it as the reward of merit. If he chances to be forgotten, or is fastened a little too far from his fodder, he neither kicks nor flies into a passion, but entreats his master, in the most pathetic language, to supply his necessities; he is right in this, for such a faithful servant deserves consideration, and who may blame him for employing all the rhetoric which he possesses? When his expostulations are ended, he waits patiently for a little bran, or hay, or it may be a few thistles, or grass; and when his hunger is satisfied, he goes to work again, or marches on in the most methodical manner. His occupations are of the humblest description, but this does not lessen their value; both men and animals are placed by their Creator in different stations, and each one has a separate duty to fulfil. The patient camel traverses burning deserts, the elephant is essential in exotic climes, the horse is indispensable in temperate and northern regions; but the patient ass, though little heeded by those who ride in handsome equipages, is the poor man's colleague, and often his most faithful friend. We owe much to the labours of the peasantry; they are, as said the Abbé, from whom we have freely quoted, the very sinews of the community; and what would often become of them, if they were not provided with a four-footed domestic on whom they can implicitly depend, and who is ever ready to convey the materials which they either purchase or manufacture. Nay, the products of their small gardens are frequently offered from door to door by his aid; a poor man would be overborne by having a heavy load upon his shoulders, but donkey thinks nothing of it; he seems to say—"Here I am, master; my back is sufficiently broad, or, if it pleases you better, I can draw a cart;" and thus food and vegetables, herbs and poultry, coals and sand, and lime or straw, are conveyed from one place to another.

Our associations with the donkey are thought to be neither classical nor poetic; and yet Spenser, in past years, and Cowper in modern ones, have written lines respecting him, of exceeding beauty. And who that has a heart to feel, can read unmoved the exquisitely pathetic ballad of Peter Bell? All boys should read it, and then, when thoughtlessly picking up a stone to throw at some unoffending donkey, they would think of the lone meadow, and the deep still water, and how beside that solitary pool stood the faithful, patient animal, by day and by night, till his hair grew rough, and his bones nearly protruded through his skin, because the master whom he had served lay there. That master was once a peasant, a father, and a husband, and the donkey who trudged beside him helped to support the family; and afterwards, when through his watchings in that isolated spot, the drowned man obtained a Christian burial, and sorrow had had her time, the same faithful beast, well curried, and reclothed with flesh, helped to feed the widow and her fatherless children.

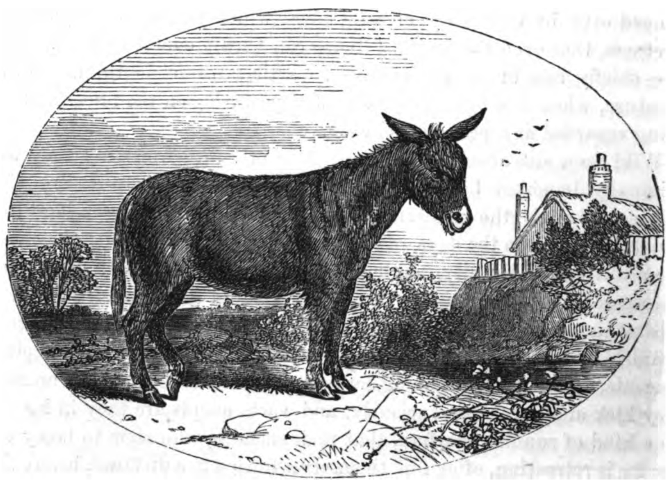
The ass was unknown to Southern Europe in the time of Alexander, according to the testimony of his tutor, Aristotle. Arabia, and other portions of the East, were his ancient haunts, and even at this day, the deserts of Lybia and Numidia, and many islands of the Archipelago, are ranged over by vast troops of wild asses, which run with such amazing fleetness, that even the swiftest horse can hardly overtake them. They are chiefly caught by the natives as articles of food—the flesh of the creature, when free to range at will, and pasturing on the finest herbage, being regarded as a peculiar delicacy.

Wild asses also abound in various parts of South America; they were originally imported by the Spaniards, and such as escaped from their masters, "made the wilderness their home, and the barren land their dwelling." As in the days of Job, so at the present time—"they scorn the multitude of the city, neither regard they the crying of the driver; the range of the mountains is their pasture, and they search after every green thing." According to the testimony of Don Ulloa, the celebrated Spanish traveller, neither the steepest hills, nor the most precipitous descents, retard their headlong course; when attacked by wild animals, they kick and bite most furiously, and such adepts are they in keeping up a kind of running warfare, that their enemies, who seem to fancy that the foe is retreating, often find themselves hurled to a distance, before they are able to look round.

Those who wish to entrap wild asses without injuring them, proceed quietly in large companies, attended by native Indians, till they reach some open space, where a herd is feeding. They then form a large circle, and gradually drive the creatures, with loud cries, into a smaller compass. This done, the most skilful hunters, mounted on fleet horses, throw their lassos with unerring aim, and having entangled their victims, leave them till the chase is over, which frequently lasts for some days.

From Asia the family of Asinus diverged into various portions of the globe, and as warm climates are especially favourable to their growth, those of Persia, Guinea, and Spain, are even larger and more beautiful than horses; in the former, two races are conspicuous; the one slow and heavy, and useful for carrying burdens, the other nimble, smooth, and stately, and chiefly reserved for the saddle. We know not at what period this valuable quadruped first appeared in Britain; but it is more than probable that its rarity and high price caused the "unhastie beast" to be chosen by the poet as a fit attendant for the Lady Una, in her wanderings.

We have adverted to the patience, gentleness, and perseverance, to the temperance and fidelity of this much-enduring animal. If he has any



THE ASS.

preference as regards his food, it is for the plantain rather than the thistle, and while seeking for it among herbage, he will pass over the choicest grasses. None but the purest running streams or brooks are selected by him wherein to quench his thirst, and so much is the creature afraid of wetting his feet, that even when loaded, he will turn aside to avoid the dirty portions of the road.

Such is the brief history of a deserving quadruped, who often shares without a murmur the privations and hardships of his master. While looking at some way-side donkey, browsing in the hedge, after a hard days work, I have thought to myself how often the lowliest are the most highly honoured. The dove is the meekest of birds, and what a glorions symbol has she been rendered. The donkey is the least regarded among domestic animals, and yet the prophet, when rapt in vision, told that he alone, among all creatures, should bear into Jerusalem the Lord of Life and Glory.

THE DOMESTIC GOAT.

"Look at Billy, what a beard he has!" Thus say the boys when a goat makes his appearance; and then the most venturesome among them either fence at the venerable appendage under his chin, or attempt

THE BOY AND THE GOAT.

to push his horns, scampering off as fast as they can run, when Billy prepares to chasten them for their impertinence.

This we have often seen, either on village commons, or in public roads; and while the passers-by have looked on and smiled at the grotesque appearance of the animal, we have thought that many might advantageously be more acquainted with the natural history of the Caprine races than they are,

Much of history and mythology, of poetry and legend, is associated with them. In Grecian annals, Pan, the fabled guardian of shepherds and of huntsmen, is represented with the horns and feet of a goat; during the spring season, Osiris, that good king of Egypt, to whom divine honours were accorded, assumed the same characteristics; and both Minerva and the Jupiter of Greece wore the ægis of a goat-skin as a breast-plate. The goat, moreover, holds a distinguished place among the constellations: by some he is presumed to commemorate the faithful services of a Cretan maiden, who nourished the infant Jupiter with the milk of her flock; but more probably, Egyptian or Chaldean shepherds named the stars within their range of vision, connecting them with animals and facts associated with pastoral life, and these, as time went on, became objects of idolatrous observances. Nor is this all. The goat was rendered a type of the Grecian or Macedonian empire; and about two hundred years before Daniel the prophet, the subjects of the latter were called Ægeadæ, or the goats' people. Caranus, the first king, as heathen authors relate, was enjoined by an oracle to take the goats for his guide to empire, when, having left his native land with a band of band of fugitives, he sought a home in Macedonia. The country through which they passed was wild and forest-like, intersected with broad streams and rocky passes, yet still they went on, looking in vain for the promised guides, till a violent storm compelled them to take shelter: at this moment a herd of goats rushed by, and Caranus, with his followers, regardless of the tempest, quickly followed them, till they came to a wide plain, on which afterwards arose the city of Edessa; hence the king, who fixed there his seat of government, made the goat his ensign, and called the city by a name implying the goats' town. This memorable spot became, in after years, the burying-place of Macedonian kings; the birthplace, also, of many who swayed the sceptre; and, in commemoration of its origin, the son of Alexander the Great was named Alexander Ægus, or the son of the goat; and many of his successors are represented, in statues and on coins, with goats' horns.

Men, in ancient times, clothed themselves with the skins of animals. To this succeeded an improved kind of vestment; when, according to the testimony of ancient writers, the long hair of the Caprine races was blended, by the aid of gum, or glue, with the softer fur of wild animals, or wool, and manufactured into a strong felt, known in northern Asia, and noticed by the poet of the "Georgics."

> " For hairy goats of equal profit are
> With woolly sheep, and ask an equal care.
> 'Tis true, the fleece when filled with Tyrian juice,
> Is dearly sold, but not for equal use :
> For the prolific goat increases more,
> And twice as largely yields her milky store;
> Meanwhile the pastor shears their hoary beards,
> And eases of their hair the loaded herds.
> Their camelots, warm in tents, the soldiers hold,
> And shield the shivering mariner from cold."

The Editors of Cuvier's " Animal Kingdom" conjecture that the black war-tunics of the Cimbri were made from this material; certain it is, that such was the winter-dress of the Roman legions stationed in Britain, and that they wore no other till the reign of Constantius Chlorus. Goats'-hair was, likewise, the chief material of Scandinavian dresses—a fact readily proved by referring to the figured vestments of their divinities in rough bas-reliefs and on coins. But, though black wàr-tunics, chiefly made of goats'-hair, continued to be worn by auxiliary cohorts, Scandinavian matrons had become acquainted with the use of the distaff, and from them it passed into Britain. Goats'-thread, at first plaited into ribbon-like stripes, and then sewn together, was gradually superseded by woollen yarn, woven at length into narrow, and, lastly, into broad pieces that formed plaids. Hence the origin of those picturesque dresses of varied colours which characterize the Highland soldier.

Goatherds, doubtless, preceded shepherds, in the northern and western regions of the world, by many ages. The learned Editors of Cuvier's " Animal Kingdom" conclude that they predominated, while the country was chiefly covered with forests; and that wool-producing animals were not brought across the Rhine, or Upper Danube, till the Roman empire fell to pieces. It was otherwise, as regards the shores of the Euxine, and throughout Greece: in Spain, Southern Gaul, and Italy; in each, flocks abounded, and without doubt the Argonautic expedition had reference to the importation of ovine races into the classic isles of the Mediterranean.

The common goat is a lively, capricious, and playful animal; by nature fond of climbing, and delighting in wild and mountainous regions: frequenting with his brethren even the borders of perpetual snow, if some favourite herbage invites them to such Alpine solitudes. You may see them standing secure on the verge of inaccessible and dangerous precipices, apparently loving to look down or gazing fearfully from the summit of a giddy height. Their small feet seem little adapted for such perilous expeditions, and yet, upon a near inspection, we notice in the hoof a beautiful adaptation of means to a desired end. The hoofs are hollow underneath, with sharp edges, and this effectually prevents them from slipping off the dangerous sites which they frequent.

ALEXANDER SELKIRK AND THE DANCING GOATS.

Goats are always in motion, searching after new objects, and ranging hither and thither; they are easily sustained, and find an ample supply of food from the spontaneous productions of the soil, in situations nearly inaccessible to all other creatures. They delight rather on heathy mountains or shrubby rocks, than in green pastures, or commons covered with herbage, the resort of sheep and bees. Those who visit the Alpine regions of Italy, Piedmont, or Switzerland, frequently notice one of these sprightly and wandering creatures looking down upon him from some high craig, or sleeping exposed to the full rays of a meridian sun. A goatherd can rarely manage more than fifty of these untractable creatures, however strong and vigilant he may be.

The poet of the "Georgics," sang of these interesting animals in Mantuan fields, among groves of mulberry-trees; and the directions which he gave to goatherds of ancient times are equally applicable to those of the present day. In the warmer regions of the globe, men, when thus employed, often pass the night in the open air. Chardin, who lived in the reign of Charles II., and reeeived the honour of knighthood at his hands, tells us that when travelling by moonlight through a solitary region in Asiatic Turkey, he was alarmed by a furious barking of dogs. The sound was welcome, for it boded the habitation of man, and the wearied company thought they were approaching a considerable village. Great, however, was their disappointment, when, on drawing nearer, they saw only some glimmering embers, beside which lay extended a few poor goatherds, wrapped in thick loose coats.

Little is known with certainty concerning the natural history of the Caprine tribe, as, though associated with men in stables, or employed to draw small carriages for children, they are not especial favourites. Few, if any, care to make companions of them, excepting boys, who rather teach them to play tricks than try to improve their natural faculties. We may infer, however, that notwithstanding their love of mischief, and predilection for cropping pet flowers when attainable, they possess excellent dispositions, and are great lovers of peace among themselves, in proof of which many interesting facts have been preserved, from which we select the following:—

It chanced one day, among the valleys of Piedmont or Switzerland, that some young children went forth on a summer holiday to gather wild flowers in a favourite glen. The spot was wild and lovely; a prattling stream leaped forth from a hollow fissure in the rock, where grew bee-orchises, and harebells of the deepest cerulean blue. The rock itself was lofty and precipitous; it was such as the boldest chamois-hunter had never essayed to climb; but wild goats pastured there, and might be often seen to look down complacently from eminences that were almost lost in the clouds. High above the clear streamlet, so high that children would gaze at it with astonishment, and ask one another, in their simplicity, if it did not reach the stars, projected a narrow crag, on which one might almost fancy that a sure-footed Alpine mouse would hardly dare to venture. The children had finished gathering flowers for an approaching festival, and sat themselves down to rest beneath the shade of a group of alders; they spread their provisions on the grass, and their ringing laughs and merry voices woke up many a sleeping echo in that quiet glen. Suddenly one of the joyous company exclaimed in a tone of alarm, "Look, look, look! what's that on the crag?" and the children all saw with terror two goats on the narrow ledge. The ledge was not only narrow, but exceedingly steep, and there was no room for the creatures to pass each other; therefore the goat which had ascended to the extreme point, could not by any possibility regain a safe resting-place, neither could the descending goat retrace his steps. There they stood, as if considering what was best to be done, while the children ran off with the utmost speed to the neighbouring village, begging all whom they met to save the poor goats. The people naturally hastened to see what was the matter, and stood with anxious upturned faces towards the ledge. It was really piteous to see the condition of the animals, whose fall they dreaded every moment. No such thing; the two venerable personages still looked one another in the face, till at length a bright thought seemed to pass their minds. The goat that was coming down, deliberately folded his legs under him, and lay as close to the ground as possible; his brother, with equal self-possession, walked warily over him, for a spring could not be ventured without imminent risk; and then the prostrate goat, having arisen, crept down to the extreme point, which admitted of turning round. A few seconds more, and the two friends were seen cropping some of the scant herbage which grows on a terrific elevation. What exclamations of delight burst from the children; and what a deafening shout was raised by the young men. The goats looked down, as if to say, "Who among you could have done the same?"

Nine different species belong to the Caprine family; none attain any considerable size, but they are equally robust, and capable of enduring both heat and cold. Endowed also with great strength and agility, such as inhabit the mountainous regions of Europe and Asia will often spring down the slippery flanks of precipices with astonishing celerity, or mount a perpendicular rock, fifteen feet high, with three successive bounds, if assisted by the slightest projections. When safe from their pursuers, they may be noticed in almost every variety of action; they run, and then stop short, leaping at one time, and apparently approaching some object with the utmost eagerness, then retiring quickly to a short distance, in the most capricious manner, as if the strange restlessness of their temperament excited them to the most eccentric movements.

The wild goat appears to be the stock of all our domestic breeds, and is distinguished by its anteriorly sharp horns, very large in the male, short and sometimes wanting in the female; which is also sometimes the case with the different ibexes. It inhabits the mountains of Persia in troops, where it is known by the appellation *pasing*, and perhaps those of several other countries, even the Alps. The *oriental bezoar* is a concretion found in its intestines.

Domestic goats vary exceedingly in size, colour, and the length and texture of their coat; also in the magnitude, and even the number of their horns. Those of Angora and Cappadocia have the longest and most silky hair. The Thibet goats are celebrated for the admirably fine wool which grows among their hair, of which the Cashmere stuffs are fabricated. There is a race in Upper Egypt with short hair, convex chanfron, and projecting lower jaw, which probably is hybrid. The goats of Guinea, termed *mambrines* and *juida*, are very small, with horns inclining backwards. All of them are robust, capricious, wandering animals that betray their mountain origin by affecting dry and wild situations, where they feed on coarse herbage and the shoots of bushes. They do much injury in forests.

The one which approaches most nearly to the common goat is the *Syrian Goat*, whose long hair was employed at a very early period for the manufacture of stuffs; whilst the milk yielded by the females has been a most important article of food to the inhabitants of that region. The *Angora Goat* has the hair longer and more silky; whilst the general aspect of the animal more resembles that of the sheep. The length and silkiness of the hair is still more remarkable in the Cashmere Goat, a native of Thibet; from which material are woven the Cashmere shawls, that are so highly valued in Europe. The quantity of wool produced by each goat is not above three ounces; and ten goats are required to furnish sufficient wool for a shawl, a yard and a half square. The wool collected in Thibet is sent to Cashmere, where it is manufactured; and a long and toilsome journey must be traversed before the shawls can be transmitted to Europe.

Among the different species that compose this gregarious family, we may briefly notice the ibex or bouquetin (*capri ibex*), as one of the most conspicuous. This agile creature principally affects the loftiest European mountains, though, probably, existing on the hills of Candia and Greece; they seek at night the most extensive woodlands, quitting them at daybreak, and ascending to open spaces. Hunters go in quest of them, among wild and terrific scenes; yet only the boldest, or most experienced,—for strong must be the nerves of him who follows with his companions the steps of the wild bouquetin. He requires not only a firm step, but strength, energy, and endurance, with the power of looking down unmoved from appalling heights.

The bouquetin is endued with strength and agility proportionate to his size, and there is exceeding difficulty in coming upon him unawares, for the creature is wonderfully endowed with means for facilitating his escape. His visual organ enables him to discern objects at a great distance; his sense of hearing is extremely acute, his smell equally so, and his huge horns, so far from offering any impediment to his rapid course, render him an essential service in protecting his head in the event of an unexpected fall, or the necessity of throwing himself from some great height to avoid his pursuers.

Others of the tribe have their geographical limits very accurately defined; the Temlah goat inhabits the highest range of Central Asia; the Ægagras is often seen among the Caucasian mountains; the Abyssinian ibex affects the rocky fastnesses of Arabia; the Caucasian ibex is confined to the region whence he derives his name.

But, as regards the domestic goat (*capra hircus*), his varieties are widely diffused through almost every part of the known world, and, however varying either in shape or the quality of their hair, they are equally valuable in their assigned localities.

Some of our young readers are, probably, acquainted with the adventures of Alexander Selkirk, an English sailor, who, more than one hundred and forty years since, was left alone on the island of Juan Fernandez.

This extraordinary man sought to beguile his solitude by rearing kids, and he would often sing to them, and dance with his motley group around him. His clothes having worn out, he dressed himself in garments made from the skins of such as ran wild about the island; these he sewed together with thongs of the same material. His only needle was a long slender nail; and when his knife was no longer available, he made an admirable substitute from an iron hoop that was cast ashore.

DOMESTIC FOWLS.

HOWEVER interesting the subject, there would be no advantage in tracing back the various breeds of domestic poultry to their common origin. They have evidently existed in a domesticated state, in many countries, from time immemorial, being incidentally mentioned in the first book of Kings, iv. 23, as forming part of the provision at the court of Solomon; and in the course of ages have branched out into numerous varieties from the parent stock. We shall proceed first to give a description of the several kinds of fowls common in England, and afterwards the proper methods of treatment, to ensure the greatest advantage and profit.

1. THE MALAY FOWL.—This is the largest fowl bred in this country; its general colour is yellow, intermixed with dark brown; being very long-legged, on that account it is not well adapted for sitting; neither is it desirable to be kept for its flesh, which is coarse, and of a dark colour. The eggs, however, are nutritious, and are of larger size than those of any other hens.

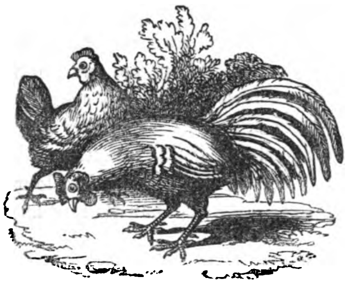
1.—MALAY FOWLS.

2.—SPANISH FOWLS.

2. THE SPANISH FOWL is the next in size; it is also long-legged, therefore the same objection applies to this as to the Malay. It is common in the neighbourhood of London. The plumage and legs are entirely black, and the combs very large and red. The flesh is white and good and the eggs nearly as large as those of the Malay hens.

3. THE DORKING FOWL is so called from the town of Dorking in Surrey, where they are to be seen in the greatest abundance, and are

said to have been first brought thither by the Romans. This fowl is the third in size of British poultry, and has a finely shaped body and small legs. Its colour is entirely white, and it may generally be distinguished by having five claws on each foot; one of which, however, is usually imperfect. The colour of the flesh is not so white as that of some of the common kinds, but inclines to a cream colour; it is, however, of fine flavour. The eggs are large, and this fowl is an abundant layer.



3.—DORKING FOWLS.

4.—POLAND FOWLS.

4. THE POLAND FOWL.—Of this there are two varieties, the one black, with a top knot of white feathers; the other gold coloured and spotted, with a dark feathered crest. The plumage is not so abundant as that of most others; their legs are short, their bodies plump; and next to the Game Fowl, they are considered to be the most beautiful in appearance. The flesh resembles that of the Dorking, being rich and juicy. These fowls have the least desire of any to sit, and from the greater number of eggs which they lay, they are the most valuable, and have been called EVERY DAY HENS, or EVERLASTING LAYERS. Their eggs are scarcely so large as those of common hens, but from the great quantity they produce, and their little tendency to sit, they are the most profitable of all the varieties.

5. THE BOLTON GREY.—This fowl may perhaps be esteemed next to the Poland; it is very little known in the south of England, and derives its name from the town of Bolton, in Lancashire, in which county it appears to be most reared. It is thus described by the Rev. Mr. Ashworth: "Small-sized, short in the leg, plump in the make. The colour of the genuine kind invariably pure white in the whole loppel of the neck; the

body white, thickly spotted with bright black, sometimes running into a grizzle, with one or more black bars at the extremity of the tail; they are chiefly esteemed as very constant layers, though their colour would mark them as a good table fowl."

5.—BOLTON GREYS.

6.—GAME FOWLS.

6. THE GAME FOWL.—This is the most beautiful and rich in plumage, of any of the gallinaceous group, and in gracefulness of figure excels them all; the flesh is superior in whiteness and flavour to that of any other; the eggs are finely formed and delicate in flavour, but rather smaller than those of ordinary fowls. This breed, however, cannot be reared to any profit, on account of the natural propensity of the birds to fight, which manifesting itself at a very early period, renders it a matter of extreme difficulty to bring up the young brood.

7. THE BANTAM FOWL.—Is a well known small breed, of which there are several varieties, some are covered with feathers down their legs, while others are as smooth-legged as the common kind. They may be made useful in hatching the eggs of partridges, as they are good nurses, and good layers. They may be used for the table instead of partridges, or young chickens: the flesh and the eggs are very delicate in flavour. Our cut represents one of the smooth-legged partridge-spotted breeds. We have here enumerated only the principal choice varieties of Fowls, but besides these, there are many other kinds produced by the continual crossing of the breeds.

If possible, the poultry-house should have a southern aspect; any out-house or shed may be rendered suitable, especially if adjoining to the dwelling-house, where the warmth from the fires at the back of the wall may serve to warm the building. This will be found very advantageous to the fowls, for, as they are originally natives of warm climates, an increased temperature is always favourable to their laying, and for the rearing of young chickens. Precautions must be taken to keep out the rains, and the keen blasts of winter, and during the continuance of unfavourable weather, the fowls must be kept shut up in their house, as rain is so injurious to them that their laying will be retarded for a long period by a thorough wetting.

The floor of the fowl-house should be formed of chalk and earth, thoroughly beaten down to form a compact solid mass, which the fowls cannot tear up, and which will bear frequent sweepings. This floor should constantly be kept clean, and well sprinkled with sand or dry ashes, and there should also be several holes filled with either of these materials, for the fowls to wallow in, as they accustomed to do, in order to rid themselves of the vermin with which they would otherwise be infested. "A better remedy, and one far speedier, and of more certain efficacy has been discovered at Windsor by her Majesty's feeder. The laying nests at Windsor are composed of dry heather (erica tetralix), and small branches of hawthorn, covered over with white lichen (lichen raugiferinus). These materials, rubbed together by the pressure and motion of the hen, emit a light powder, which, making its way between the feathers, to the skin, is found to have the effect of dislodging every species of troublesome parasite."

The perches for the fowls to roost on should not be placed one above the other, for obvious reasons, but in a continuous line around the house. Pegs driven into the wall may serve as steps for them to ascend to roost, but these must be so arranged as to form a proper slope for their convenience.

The nests for laying are recommended by some to be formed in boxes, or baskets, arranged around the room, either upon the floor, or at any height that may be convenient. Clean straw is preferable to hay for nests, as being less liable to harbour vermin, or become musty.

But the best form is a box with a side entrance, as the hen is not so liable to break the eggs as when she jumps down from the top upon them. The more secluded the nest can be placed the better, as the hen is so fastidious and prudish, and has so much mystery about her laying, that she *will* have secrecy. If you watch her proceedings, she is annoyed, and is probably prevented from laying, and may be stopped altogether for some time.

In the nests there should be several chalk eggs, in order to induce the hens to lay there.

After the fowls have gone out, the door and window of the house should be opened, and occasionally a small quantity of hay or straw should be burned in it, to renew the air, and to destroy noxious insects. The nests, perches, food-troughs, &c., should be frequently scraped and washed, and the ground often swept, scraped, and covered with ashes.

FOOD.—Nature teaches the fowl the kind of food most suitable, and in this, as in all other matters, if we follow nature, we shall do much better than by adopting the notions of those persons who recommend the most extraordinary compounds as food for fowls. "They are of all birds the most easy to feed; nothing is lost to them, they are seen the whole day long, incessantly busied in scratching, searching, and picking up a living. The finest, the most imperceptible seed cannot escape the piercing looks of a fowl. The fly that is most rapid in its flight, cannot screen itself from the promptitude with which she darts her bill; the worm which comes to breathe at the surface of the earth, has not time to shrink from her glance, but is immediately seized. The food of fowls consists of several sorts of grain, fruit, insects, and worms. A good way to rid the gardens of caterpillars, worms, and other little creatures that eat up the produce, would be to let in hens, if by their habit of scratching the ground they did not cause more damage than service.

Barley is the best corn for poultry, it should form their staple food. Oats are sometimes used, but not so advantageously, besides they are apt to scour young chickens. They are recommended by some as promoting laying, but for this purpose hempseed, buckwheat, and millet, are better.

To keep fowls in health, they should be supplied with a sufficiency of vegetable diet, such as cabbage, lettuce, beet, carrots, potatoes, &c., either raw or boiled. In the winter too, when they cannot procure worms or insects, it is very necessary to give them small quantities of animal food, as bacon-rind, odd bits of meat, &c., chopped small, as substitutes; or the bones may be given to them to pick, which will be of great service in forwarding their laying.

Hatching and Rearing the Young Brood.—The eggs for setting n must not be more than three weeks old, for fresh eggs produce the ealthiest chickens, and are easiest to be hatched. Choose those eggs which have been properly fecundated; those of your own best hens of two years old, are to be preferred, as you may be sure of them, if you have taken care to allow but five or six hens to one cock, for the purpose of producing eggs for hatching. If you examine the eggs by candle-light, a small vacancy or air-bladder may be observed in the interior, at the larger end of the egg; if this be exactly in the centre, it is the germ of the male bird, but if a little on one side, it is that of the female; this is useful to be known, as then the supply of either kind can be properly regulated.

When the eggs are thus chosen, as soon as possible after they are laid, they should be put away in dry saw-dust, in a cool place, until the time of setting.

The number of eggs given to a hen for hatching must be proportioned to her size and ability to cover them. More, however, may be given in summer than in winter; a hen that will hatch sixteen or eighteen in May or June, should not have more than twelve in February or March.

The desire of most hens to sit when they have finished laying is very great, but it is not enough that they appear to have a disposition for it, as it often happens that a hen will commence incubation, and then forsake her nest, after setting on the eggs sufficient time to addle them. Those most likely to perform the service best, are at least two years old, not easily frightened, having large wings, and their bodies well supplied with feathers, above all with short legs, that they may sit close.

To try the qualification of the hen, she should be set for a few days on a nest with some worthless eggs; if she appear steady, and there is reason to suppose the sitting will be permanent, let the useless eggs be removed, and the selected eggs placed under her; she may then be covered with a clean cloth, as a necessary precaution against her leaving the nest; when her morning meal is given the cloth may be taken off, and replaced as soon as she has entered the nest. Some hens sit so constantly, that it is absolutely necessary to lift them off their nests, in order that they may take food and drink; corn and water should be placed near them that if they please they may take what they require at any time. Great care must be taken that the eggs be preserved from cold, especially towards the end of hatching, or the young will certainly perish in their shells.

Spring and autumn are the most favourable times for sitting; then eggs are more plentiful and in better condition, and the temperature is more suitable.

The eggs should never be disturbed after they are in the nest; recent experiments have proved that they need not be turned as generally practised, but that this should be left to nature.

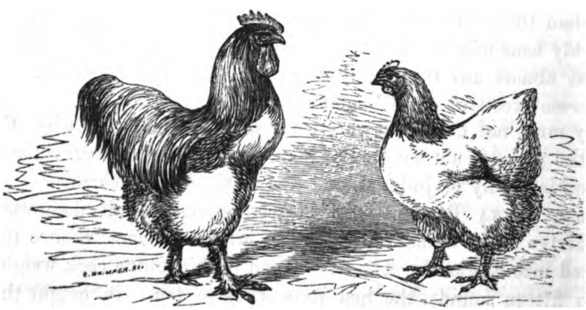
On the twenty-first day of incubation, hatching is usually complete; the little chicks peck through the shell, and free themselves from their prison. No attempt should be made to break the shell, and liberate them before the time, though a little assistance is sometimes necessary, when some are found too weak to free themselves by their own effort; but this requires great care and dexterity, as the least injury inflicted, results in the death of the chicken. Rather than be too hasty, it will be better to wait at least twelve hours before attempting their liberation.

The chickens first hatched are to be taken away from the hen, lest she should be tempted to forsake her nest, leaving some to perish. They should be placed in a basket with soft wool, and if the weather be cold put in a warm apartment or near the fire. They will not require food for twenty-four hours, by which time all the rest of the brood will be hatched; they are then to be placed altogether with the hen under a coop in a place apart, and supplied with food and water. Bread-crumbs, or the smallest grains of wheat form the best food, or oatmeal slightly moistened, and curds chopped small may be given. The water must be very clean and fresh, and placed in such pans that they may be able to drink from, without wetting themselves. The hen need not be cooped more than three days, she will scratch for worms and insects which will be highly beneficial to her young brood. In a few days the chickens will eat almost any thing, a little animal food, or earth-worms chopped fine, forms excellent nourishment for them.

They must not be let out very early in the morning, or when the dew is on the ground, nor suffered to roam among the damp grass; cold and moisture is highly prejudicial, and frequently fatal to them.

Cochin China Fowls.—The largest species of all domestic fowl. They derive their name from Cochin China, the place whence they are imported into England. The full-grown Cochin China cock weighs from nine to fifteen pounds, the hen from seven to ten. In height the male bird grows from twenty-two to twenty-five inches, the female from eighteen to twenty-two inches. Owing to the difficulty which this fowl has of ascending from and descending to the ground, the perches should not be raised much more than two feet. Where Cochin China fowls are kept in great numbers, a range of roosts should be erected; the first a foot in height, the second two feet, and so on, whilst the last should have an intervening space between it and the wall, sufficient to allow the birds abundant room when roosting. For obvious purposes of cleanliness, the perches should not be erected immediately one above another; they should be tolerably thick, because the great length of toe and weight of the body, characteristics of this fowl, render it absolutely necessary that their claws should retain a firm clutch, without too great an effort to maintain their equilibrium. Sometimes they are allowed to roost on the ground, and in that case the litter must be cleansed away daily, especially in summer time; but when perches are used, a thorough cleansing once or twice a week, according to the number kept, will be sufficient.

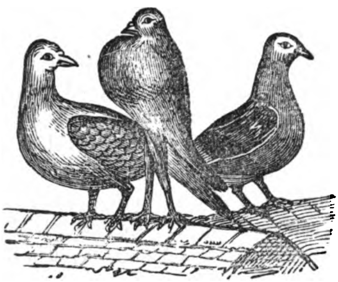
The chickens are remarkably strong and hardy, thriving well from the moment of their birth until they arrive at mature growth. Rice is their natural and proper food; it should be prepared by boiling or steaming until the grain is considerably swollen, but on no account should it be smashed or broken up. This food, however, owing to its binding properties should be occasionally changed. Barley, well steamed and soaked for five or six hours, will be found a beneficial and nutritious food. Sopped bread, bread and milk, boiled liver, and raw beef chopped fine, eggs boiled about twenty minutes and cut small, these may all be given by turns in small quantities.



PIGEONS.

This extremely beautiful race of birds has been held in high estimation, both in ancient and modern times, as well for the pleasing amusement they afford, as for the profit to be derived from them, as articles of sale or of domestic consumption.

The pigeon lays two eggs, and then sits; the eggs are hatched nearly at the same time, as she does not sit closely upon the first egg until the second is laid. The nest is of the rudest possible construction; a few sticks or straws laid across each other, generally serve the purpose; often, indeed, pigeons do not take the trouble to make a nest at all, but lay their eggs upon the flat surface of the floor of their nests, in which case the eggs do not lie closely together during the progress of incubation, but are in danger of being broken by rolling on to the ground. In Germany, to prevent this, nests are provided made of straw, something like the top of a bee-hive turned upside down, the eggs naturally roll together at the bottom, and receive equal warmth while hatching.



Food and Water.—Tares or small horse-beans, called "pigeons' beans," form the best, as well as the cheapest food for pigeons; but peas, both gray and white, barley, wheat, hemp, and rape-seeds, may be occasionally given with advantage. The food of whatever kind, should be supplied twice a-day, early in the morning and in the afternoon. On each occasion, just as much as they can eat should be given, so that there may be no waste by the scattering about of the grain, which is the case when a supply is always kept on the floor of the pigeon-house.

A constant supply of fresh water must be provided, not only for drink, but also that the pigeons may bathe themselves, which they frequently have occasion to do, in order to rid themselves of vermin. A large earthen pan will answer for both purposes, but the water must be often changed.

Pigeon-house.—When many pigeons are to be kept, the best place is an empty chamber or garret, which is warm and dry, and where they can be open to observation. The space between the roof of a house and the ceiling of the upper chamber may be very well appropriated for this purpose. An opening should be made through the tiles or slates for the going in and out of the pigeons, and have a covering resembling a dormer or garret window, in order to keep the wet out. This outlet should, if possible, face the south, or south-east, and be well sheltered from cold, from high winds and heavy rain; because if much exposed to the weather, the growth of the young pigeons is delayed, and the health of the older ones sensibly affected.

Around the interior of the loft, a row of compartments for the pigeons must be fixed at any convenient height. Shelves placed one above another at eighteen inches apart, and divided by partitions placed at the same distance from each other, then boarded up in front, leaving outlets for the pigeons, is the simplest plan that can be adopted. Any boy, with a little ingenuity, will be able to construct these apartments, as it is not necessary that any fixed plan should be followed, only care should be taken to allow height enough for fancy breeds if they are kept, and eighteen inches will be quite sufficient for that purpose.

The floor of the pigeon-house should be strewed with fine gravel, which is as necessary and beneficial to the health of pigeons, as it is to fowls. A little lime rubbish sprinkled with salt and water is also beneficial. Pigeons are very fond of salt, and for this reason the "salt cat," is often introduced into the house: not a *real* pussy, but a composition of the following materials. About a gallon each of gravel, earth, and old mortar from walls; half-a-pound each of carraway, hemp, and mustard seeds, two or three ounces of bay salt; all to be well mixed with strong brine, and then baked in a pan, as a cake or pudding. When sufficiently dried, and become cold, it is to be placed upon the floor of the pigeon house, where it will afford a constant source of enjoyment to the pigeons in picking out the seeds, besides contributing to keep them in health.

Nests.—Each pair of pigeons should have two nests closely adjoining, yet separated from each other by a partition; for good breeders, generally at the same time they have young to attend to, have also eggs to hatch, and where there is no separation between the nests, the hen, while sitting, may be annoyed by the young birds, and compelled to quit her nest.

RABBITS.

The present article will be about rabbits, those pretty little creatures, of which most boys are so fond, and which afford them useful occupation. We are going to give them some useful information respecting the best methods of breeding, rearing, and managing rabbits in general; and our remarks may probably prove useful to older persons, who may think it worth while to take the pains of paying attention to this useful and profitable species of live stock.

Almost every boy in the course of his life takes a fancy to rabbit-keeping, and yet scarcely one boy have we met with, who knows how to treat the animals properly. Many rabbits, we are sorry to say, have been starved by neglect (not wilfully perhaps), poisoned with filth, or foul air, or otherwise destroyed by injurious treatment. While on the other hand many are killed with kindness, by supplying them with an over-abundance of certain kinds of food improper for them. We now wish to point out these things, and to give judicious practical directions for the management of rabbits.

Rabbit House.—The first and most important matter is to have a good dry house or shed, in which the animals can be well protected from damp weather. Too much moisture is as fatal to rabbits as it is to sheep; it gives them the rot. Dampness may be all very well for fishes, but is not good for men, women and children, nor yet for horses, cows, pigs, poultry, bees, or rabbits; these all thrive better and are preserved from many diseases by being protected from it.

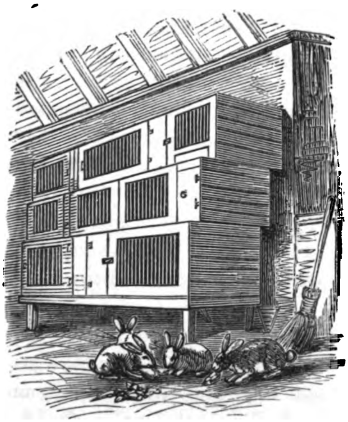
But though you keep out the wet from your rabbit-house, you must not at the same time exclude fresh air; for rabbits can no more be in health without *fresh air*, than human beings. Remember what has been said to you on this subject of ventilation, it is sheer folly to suppose that any living creature can be maintained in health and vigour without an ample supply of that "balm of life," Fresh Air. Disease and death are the natural consequences of a vitiated atmosphere to a little rabbit as to ourselves.

Many writers strenuously advise that rabbits should not be kept in hutches, but in little houses, so constructed, that they may have protection from the weather, and at the same time enjoy their liberty, and amuse themselves. This house may be built about four or five feet square, as may be convenient, with a roof formed to carry off the rain.

The floor should be boarded or paved, to prevent the rabbits from burrowing, and have hay or straw laid on it. Some boxes must be provided, placed on the floor with the open side downwards, and with holes at the side for the rabbits to go in or out. Sliding doors to these boxes are convenient to shut in the rabbits when necessary.

In the front of the house there should be a little court or yard railed off, into which the rabbits may be allowed to run when the weather is dry; and here they will sport and enjoy themselves, and give you opportunities of observing their pretty antics.

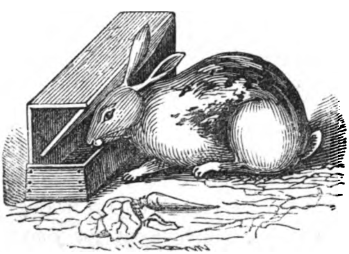
But this house will only do for *young* rabbits, or until they are about five months old; after that age, they would begin to tear each other to pieces, if left together; all the pleasure you had in witnessing their former harmony and happiness would be gone; the bucks would fight dreadfully, and the litters the does might have, would be destroyed, so that it is necessary that breeding does should be kept in hutches, and the bucks be separated from one another. But we nevertheless advise that young rabbits should be allowed to have their liberty in such a house, as they will be far more healthy, and will grow much better, than when they are cooped up in hutches, where they have no room to exercise their limbs. Rabbits of any age, from the time they are taken from the doe, up to five months old, may be introduced among the "*happy family*" in the house, they will be received with cordiality, and will skip and caper about with pleasure, just as boys may do who live in peace and love with their companions.



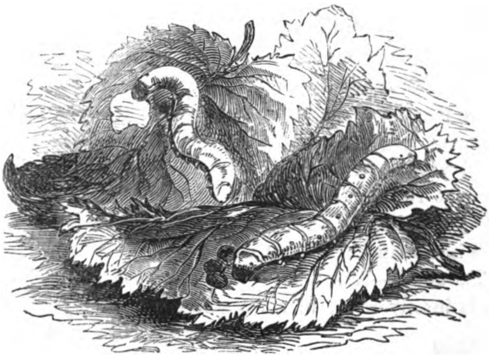
Hutches.—The hutches should be made as large as convenient, that the rabbits may not be cramped for want of exercise; those for breeding does must have a partition, so as to form two apartments, one for feeding, the other as a bed. Single hutches, that is, with one room only, will do for young rabbits, or for bucks to be kept in. The door of the feeding apartment should have wires in it, but that of the bed-place must be of wood, as the doe likes darkness and concealment when she has her litter. It is well to have a sliding-board to divide the two compartments, and to shut out the rabbits when the hutch is to be cleaned, as it is very inconvenient to do this with the rabbits running about. The floors of the hutches should be quite smooth, that the wet may run off, and in order to facilitate this a small slit or opening in the floor at the back of the hutch should be made, and the hutch itself be put sloping, a little higher at front than at the back, for when rabbits have much green food, there is a considerable quantity of moisture which requires to be drained off, that the creatures may be kept dry and clean; and if proper means be taken to receive this into a drain, it forms a very valuable liquid manure.

The hutches may be arranged one above the other around the house, to any convenient height, only it must be observed that each row of hutches should project at the back beyond that under it, in order that the wet may not run down into the hutch beneath. If a trough be placed on the floor behind the hutches, it will serve to carry off the liquid manure into some convenient receptacle.

FEEDING TROUGHS.—Are usually made in the form of a long open box, but this is inconvenient in many respects, as the young rabbits get in and spoil the food, and the older ones scratch out much of it, tread it under foot and waste it. A better plan is to have a swinging board in front, the cost of which is soon made up by the food saved. The rabbits when they take their food, push this board inwards with their forehead, and when the head is withdrawn the board flaps back against the front of the trough. Some persons have a lid to the trough which the rabbit soon learns to lift, and which shuts down again of itself as soon as the head is taken out of the way.



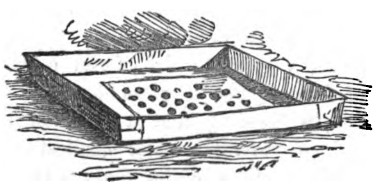
There are many KINDS OF RABBITS, varying in size, form, colour, length of legs or fur, and position of the ears, but the races have been so continuously intermixed, and varied, by breeding, that it is a difficult task to point out any distinct kind as preferable. The smallest and short-legged variety, of the colour of the wild rabbit, appears to be the hardiest. Boys generally prize LOP-EARS, though they are scarcely so pretty in appearance as the common kind. There is the *single* or *double* lop, according as one only, or both ears are dropped. SMUTS too are favourites, either *single* or double. The smut is a black spot on the side of the rabbit's nose, and a spot on each side constitutes the double smut. Some of these are very beautiful creatures, having a white silvery fur, with rich, glossy, black spots, and they are generally large-sized rabbits.



REARING AND MANAGEMENT OF SILK-WORMS.

IT is supposed that the Chinese were the first who discovered the use of this important little creature, the silk-worm. It was introduced into Europe in the sixth century by two monks who had resided many year in China as missionaries. Silk-worms are now kept on an extensive scale in India, Italy, and the south of France, and to a very small extent in England. The rearing of silk-worms is a pretty employment for young people, and some little girls are very successful in the management of them.

The eggs, which may be purchased in Covent Garden Market, should



be laid out towards the end of April in small trays made of thin cardboard or stiff paper, two or three inches square, and the rim one inch high. These should be neatly made, and well fastened together at the corners. The trays should be placed in the warmest and sunniest window in the house, and must be carefully kept from anything touching them. Some cover the trays with fine gauze. Towards June the eggs will be hatched. They should then be removed by means of a light feather or fine camel's-hair pencil into fresh trays, made as before, in which fresh young mulberry leaves must be first placed. This operation must be performed with great care, as the worms are so small and tender that a very little injury kills them.

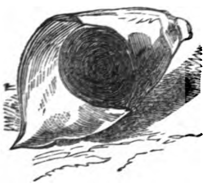
At first the worm is of a darkish hue, but afterwards becomes a delicate cream colour. All silk-worms appear to be troubled with sickness from their first appearance until they are fully grown and begin to spin. Each sickness continues about three days, during which the worm becomes thicker and shorter, and casts its skin; while this is going on it has no appetite, and therefore eats nothing.

Before the first sickness mulberry leaves should be given once a-day; after that, until the third sickness, they should be fed twice a-day, increasing the quantity according to their growth. From the third to the fourth they must be fed thrice a-day, and four times if the weather be very hot. From the fourth crisis they must be fed very frequently, as they require more than during all their previous life. Indeed, after so much sickness it is not surprising that their appetites should be pretty keen.

Lettuce leaves are often given to silk-worms instead of mulberry, but as the latter is their natural food, they must have it as soon as possible. It is said to be fatal to give lettuce after once being fed with mulberry leaves.

In cleaning out the trays, which should be attended to once a-day at first, and afterwards oftener, great care must be taken not to injure the silk-worms. The best plan is to place fresh leaves in the tray to be cleaned, upon which the silk-worms will crawl, when they can be lifted into the clean tray. Until they are full grown, they must not be taken by the fingers, and then only with great care and tenderness. The leaves must be fresh, but free from damp. It is well to keep them closely packed together, and dried in a clean cloth before giving them to the silk-worms.

Before the worms commence spinning, they change to a pink colour, and become very restless. When they cease eating, which will now be the case, remove them into little paper bags, made in the shape of a small cone or funnel, wide at the mouth, and narrowing to a point at the other end. These little bags should be about four inches deep, and may be pinned to a tape, with the narrow end downwards, and fastened to the wall of a room. It is in these little bags that the worm spins its pretty covering, completely enclosing itself in a ball of silk. This is called a cocoon, inside which the worm undergoes another change, and becomes a dark-brown, hard, glossy little grub, or 'aurelia.' When the cocoon has become as large as a pigeon's egg, it may be shaken, and if the aurelia be loose, which will be known by a slight rattling sound, the spinning is complete.



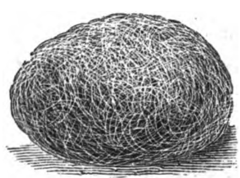
Now is the time to wind off the silk: the loose outside floss must be removed, and the cocoon placed in luke-warm water. The end of the silk will then become loose, and several cocoons may be wound off together in one thread.

When the aurelia comes out of the cocoon, it should be placed in bran, just under the surface, when it will soon turn to a white moth, which

Silk-worm Moth.

Aurelia.

does not eat, nor fly, though it has wings—lives for a very short time, lays its eggs, and dies. The eggs, however, must be taken care of if silk-worms are to be kept another year. This may be done by placing the moths in paper trays, with a piece of clean white paper at the bottom to receive the eggs.



The Cocoon.

THE ILLUSTRATED BOYS' OWN TREASURY OF

OUTDOOR SPORTS.

CRICKET.

In the early morning, when the birds are carolling their hymns of thankfulness, for sunny skies, and Nature's abundance, and,

> " The flowers are everywhere: here smiles the rose,
> And here the tulip—flower of wondrous worth!
> There is the shadow which the myrtle throws;
> The lilies white are weeping on the earth
> The tears bequeathed by morn,"

it is refreshing to betake ourselves to the green fields; and, with a few agreeable companions, to enjoy an interval of recreation; or, when the potent beams of the sun are softened, and evening steals quietly over the scene; when the labours of the day are over, and the body is disposed to exercise, then the joyous cricketers can give themselves up to the cheering influence of the sport, and forget grim care,

The game of cricket has, within the last few years, made some progress in public favour. In parts of the country, where it was almost unknown, it has now a large and increasing body of admirers. It is, indeed, a pastime for all,—peer, patriot, or peasant! For the first, it has the inducements of elegance, grace, and dexterity; for the next, it is one of the few legacies of our forefathers still free and untaxed; and, for the last, it possesses all the charms that rustic emulation and hilarity can desire.

For the guidance of those of our young friends who may feel disposed to form a club amongst themselves for this game, we append the following rules, which are usually termed

THE LAWS OF CRICKET.

1. *The ball.*—At the beginning of each innings, either party may call for a new ball.

2. *The bat*—May be generally four inches and one quarter in the widest part, and about thirty-eight inches in length.

3. *The stumps*—Must be twenty-seven inches out of the ground; the bails eight inches in length; the stumps of sufficient thickness to prevent the ball from passing through.

4. *The bowling crease*—Must be in a line with the stumps, six feet eight inches in length, the stumps in the centre; with a return crease at each end, towards the bowler, at right angles.

5. *The popping crease*—Must be four feet from the wicket, and parallel to it; unlimited in length; but not shorter than the bowling crease.

6. *The wickets*—Must be pitched opposite to each other by the umpires, at the distance of twenty-two yards.

7. It shall not be lawful for either party, during a match, to alter the ground, without the consent of the other, by rolling, watering, covering, mowing, or beating.

This rule is not meant to prevent the striker from beating the ground with his bat near to the spot where he stands during the innings, nor to prevent the bowler from filling up holes with sawdust, &c., when the ground shall be wet.

8. After rain, the wickets may be changed, with the consent of both parties.

9. The bowler shall deliver the ball with one foot on the ground behind the bowling crease, and within the return crease; and shall bowl four balls before he change wickets, which he shall be permitted to do only once in the same innings.

10. The ball must be bowled. If it be thrown or jerked, or if the hand be above the shoulder in the delivery, the umpire must call "No ball."

11. He may require the striker at the wicket from which he is bowling to stand on that side of it which he may direct.

12. If the bowler toss the ball over the striker's head, or bowl it so wide that it shall be out of the distance to be played at, the umpire (even although he attempt to hit it) shall adjudge one run to the parties receiving the innings, either with or without an appeal from them; which shall be put down to the score of wide balls, and such ball shall not be reckoned as any of the four balls. When the umpire shall have called "Wide ball," one run only shall be reckoned, and the ball be considered dead.

13. If the bowler deliver a "No ball," the striker may play at it, and be allowed as many runs as he can get, and he shall not be out except by running out.

14. In the event of no run being obtained by any other means, one run shall then be scored. In the event of a change of bowling, ONE BALL shall be allowed for the sake of practice.

15. At the beginning of each innings the umpire shall call "Play;" from that time to the end of each innings, no trial-ball shall be allowed to any bowler.

16. The *striker is out*, if either of the balls be bowled off, or if a stump be bowled out of the ground;

17. Or if the ball, from a stroke of the bat, or hand, but not wrist, be held before it touch the ground, although it be hugged to the body of the catcher;

18. Or if, in striking, or at any other time while the ball shall be in play, both his feet be over the popping crease, and his wicket put down, except his bat be grounded within it;

19. Or if, in striking at the ball, he hit down his wicket;

20. Or if, under pretence of running, or otherwise, either of the strikers prevent a ball from being caught;

21. Or if the ball be struck, and he wilfully strike it again;

22. Or if, in running, the wicket be struck down by a throw, or by the hand or arm (with ball in hand), before his foot, hand, or bat be grounded over the popping crease (but, if the bail be off, a stump must be struck out of the ground);

23. Or if any part of the striker's dress knock down the wicket;

24. Or if the striker touch or take up the ball while in play, unless at the request of the opposite party;

25. Or, if with any part of his person he stop the ball, which, in the opinion of the umpire at the bowler's wicket, shall have been delivered in a straight line to the striker's wicket, and would have hit it.

26. If the players have crossed each other, he that runs for the wicket which is put down, is out.

27. A ball being caught, no run shall be reckoned.

28. A striker being run out, that run which he and his partner were attempting shall not be reckoned.

29. If a lost ball shall be called, the striker shall be allowed six runs; but if more than six shall have been run before "Lost ball" shall have been called, then the striker shall have all that have been run.

30. After the ball shall have been settled in the wicket-keeper's or bowler's hand, it shall be considered dead. If, when the bowler is about to deliver the ball, the striker at his wicket shall go outside the popping crease before such actual delivery, the said bowler may put him out, *unless* (with reference to law 22), *his bat in hand, or some part of his person, be within the said crease.*

31. If the striker be hurt, he may retire from his wicket, and return to it any time during that innings.

32. If a striker be hurt, some other person may stand out for him, but not go in.

33. No substitute in the field shall be allowed to bowl, keep wicket, stand at the point, cover the point, or stop behind, in any case.

34. If any fieldsman stop the ball with his hat, the ball shall be considered dead, and the opposite party shall add five runs to their score; any be run, they shall have five in all.

35. The ball having been hit, the striker may guard his wicket with his hat, or with any part of his body except his hand; that the 24th law may not be infringed.

36. The wicket-keeper shall stand at a reasonable distance behind the wicket, and shall not take the ball for the purpose of stumping, until it

has passed the wicket; he shall not move till the ball be out of the bowler's hand; he shall not by any noise incommode the striker; and if any part of his person be over or above the wicket, although the ball hit it, the striker shall not be out.

37. The umpires are sole judges of fair and unfair play, and all disputes shall be determined by them, each at his own wicket; but, in case of a catch, which the umpire, at the wicket bowled from, cannot see sufficiently to decide upon, he may apply to the other umpire, whose opinion shall be conclusive.

38. The umpires, in all matches, shall pitch fair wickets, and the parties shall toss up for the choice of innings.

39. They (the umpires) shall allow two minutes for each striker to come in, and fifteen minutes between each innings. When they shall call "Play," the party refusing to play shall lose the match.

40. The umpires are not to order a striker out, unless appealed to by the adversaries.

41. But if one of the bowler's feet be not on the ground behind the bowling crease, and within the return crease, when he shall deliver the ball, the umpire unasked, must call "No ball."

42. If either of the strikers run a short run, the umpire must call, "One short."

43. No umpire shall be allowed to bet.

44. No umpire is to be changed during a match, unless with the consent of both parties, except in violation of the 43rd law: then, either party may dismiss the transgressor.

45. After the delivery of four balls, the umpire must call "Over," but not until the ball shall be finally settled in the wicket-keeper's hand, or that of the bowler, the ball shall then be considered dead; nevertheless, if any idea be entertained that either of the strikers is out, a question may be put previously to, but not after, the delivery of the next ball.

46. The umpire must take especial care to call "No ball," *instantly upon delivery;* "Wide ball," as soon as ever it shall pass the striker.

47. The players who go in second shall follow their innings, if they shall have obtained 100 runs less than their antagonists.

48. When one of the strikers shall have been put out, the use of the bat shall not be allowed to any person till the next striker shall come in.

In playing the game of cricket, each person engaged has his special duty to perform. The "batsman" should stand as close to the block-hole as possible, and as near the popping-crease as he can, so as to be on his ground. When the word "play" is called, he should take up a firm position on his right foot, with his left shoulder forward, and the left elbow well up. He should endeavour to hit any ball that comes within his range, noticing particularly how the ball pitches, so that he may guess how far it is likely to rise, and judge whether it is worth while to hit it hard, and so get a run, or to block it. When blocking,

never allow the tip of the bat to come before the handle, as in that case the ball will rise in the air, and probably cause the bowler to catch it. One of the most effective defences of the wicket is called the draw.

which is adopted when a ball pitched some feet short in length comes within the line of the leg stump. In this the bat is drawn up with its point to the ground in a perpendicular line, and the top of the ball caught a little above its centre. In striking generally, keep the bat as nearly perpendicular as possible, by doing which more of the wicket is covered than when bearing either to the right or the left. In forward play, it is not safe to play the bat above four feet from the pitch of the ball. Concurrently with observing these precautions, the general aim of the batsman is to strike the ball in such a manner as to send it to a distance in the field.

The "bowler" should have a quick eye, a strong arm, and a dexterous hand. The ball should be delivered with a run, with one foot in; and should be held with the seam across, so that the ends of the fingers touch it. The object of the bowler being to get out the striker by sending the ball through the wicket, he should, from time to time, change his style of bowling, now swift, and now slow, according as his judgment dictates. It is best to bowl slowly at first, then twisting, then straight, then quick, then quick and twisting, then quick and straight, and so on. In slow bowling, the ball should be pitched about three yards and a-half from the wicket; in quick bowling, about five yards.

The "wicket keeper" is placed about a yard and a-half behind the wicket, and stands with his left foot forward, and with his eyes and hands ever ready for action. It is the wicket-keeper's office to see that all the fieldsmen are at their proper posts, and also to direct their motions, so as to guard against the peculiar play of each batsman. Should the batsman leave his wicket unguarded, in running, it is the especial duty of the wicket-keeper, having the ball returned, to catch it, and knock down his wicket. "Short-slip" stands within three yards of the wicket-keeper on the right side. His duty is to secure the ball when it passes on one side of the wicket-keeper, and to take his place when he runs after the ball. "Long-slip" stands about twelve yards from the wicket, and a little behind it, and covers both slip and point. He must be extremely apt at catching the ball; for, if it passes him, there may be a run for it, and many runs gained. "Long-field on, and Long-field off."—These stand opposite to each other on different sides of the field, and sometimes vary their places. They must be able to throw the ball up quickly and straight to the wicket-keeper. "Mid-wicket" should stand about ten yards from the bowler's wicket,

off-side, but a little in advance. This is the most important post in the field, and ought to be well kept; he takes the bowler's place, if necessary. "Cover-point" should stand between point and mid-wicket off-side, a little removed backwards, so as to cover point. "Point" is placed about seven yards from the striker, in a line a little in advance on the off-side. He should be very nimble and active; able to catch well, and not backward in jumping a few feet into the air to catch the ball. "Long-stop" stands twelve yards behind the wicket, to throw up the ball when it has passed the wicket-keeper. "Leg" stands a little beyond the wicket, and about fifteen yards from it. It is his duty to back up balls from the off-side, from whatever direction they may be thrown.

SKATING.

The Dutch (male and female) enjoy the celebrity of being the best skaters in Europe: we are led, however, to understand that some speculation is hazarded upon their claims to the honour, and that it is the intention of our own "fair and brave" to oppose the verdict.

Skating is by no means a recent invention, and probably proceeded from necessity rather than a desire for amusement. It is difficult to ascertain at what period it made its appearance in England; some traces are evident in the thirteenth century, when it was customary, in the winter, for the young citizens of London to fasten the leg-bones of animals under the soles of their shoes, by binding them round their ankles, and then, taking a pole shod with iron in their hands, to push themselves along by striking it against the ice; and, we are told, that "they moved with celerity equal to a bird flying through the air, or to an arrow from a cross bow." The wooden skates, shod with iron or steel, which are bound about the feet and ankles, like the *talares* of the Greeks and Romans, were most probably introduced here from the Low Countries, where it is said they originated.

Fitzstephen mentions an odd pastime which formerly used to be practised. "Some make a seat of ice as large as a millstone, and having placed one of their companions upon it, they draw him along; when it sometimes happens that moving upon slippery places, they all fall down headlong."

Instead of these seats of ice, the moderns have substituted sledges, which, being extended from a centre by means of a strong rope, those who are seated in them are moved round with great velocity, and form an extensive circle. Sledges of this kind were set upon the Thames in the time of a hard frost, at the commencement of the last century.

Lady Montagu tells us that "the favourite diversion of the Germans, during the first months of winter, is sliding about in little machines fixed upon a sledge, called *traineaux;* they are large enough to accommodate a lady and gentleman, are drawn with one horse, and move with prodigious swiftness. The lady, the horse, and traineaux are all as fine as they can be made; and when there are many of them together, it is a very agreeable show."

Walker, in his "Manly Exercises," gives the following directions to skaters, which will be found very useful to beginners;—

DRESS OF THE SKATER.

"A skater's dress should be as close and unincumbered as possible. Large skirts get entangled with his own limbs, or those of the persons who pass near him; and all fulness of dress is exposed to the wind. Loose trousers, frocks, and more especially great-coats, must be avoided; and indeed, by wearing additional under-clothing, they can always be dispensed with.

"As the exercise of skating produces perspiration, flannel next the chest, shoulders, and loins is necessary to avoid the evils produced by sudden chills in cold weather. The best dress is what is called a dress-coat, buttoned; tight pantaloons, and laced boots (having the heel no higher than is necessary for the peg), which hold the foot tightly and steadily in its place, as well as give the best support to the ankle; for it is of no use to draw the straps of the skate hard, if the boot or shoe be loose."

PRELIMINARY DIRECTIONS.

"Either very rough or very smooth ice should be avoided. The person who, for the first time, attempts to skate, must not trust to a stick. He may make a friend's hand his support, if he require one; but that should soon be relinquished in order to balance himself. He will probably scramble about for half an hour or so, till he begins to find out where the edge of his skate is.

"The beginning must be fearless, but not violent; nor even in a hurry. He should not let his feet get far apart, and keep his heels still nearer together. He must keep the ankle of the foot on the ice quite firm, not attempting to gain the edge of the skate by bending it, because the right mode of getting to either edge is by the inclination of the whole body in the direction required; and this inclination should be made fearlessly and decisively.

"The leg which is on the ice should be kept perfectly straight; for, though the knee must be somewhat bent at the time of striking, it must be straightened as quickly as possible without any jerk. The leg which is off the ice should also be kept straight, though not stiff, having an easy but slight play, the toe pointing downwards, and the heel within from six to twelve inches of the other.

"The learner must not look down at the ice, nor at his feet, to see how they perform. He may at first incline his body a little forward, for safety; but hold his head up, and see where he goes, his person erect, and his face rather elevated than otherwise.

"When once off, he must bring both feet up together, and strike again, as soon as he finds himself steady enough, rarely allowing both feet to be on the ice together. The position of the arms should be easy and varied; one being always more raised than the other, this elevation being alternate, and the change corresponds with that of the legs; that is, the right arm being raised as the right leg is put down, and *vice versâ*, so that the arm and leg of the same side may not be raised together.

"The face must be always turned in the direction of the line intended to be described. Hence, in backward skating, the head will be inclined much over the shoulder; in forward skating, but slightly. All sudden and violent action must be avoided. Stopping may be caused by slightly bending the knees, drawing the feet together, inclining the body forward, and pressing on the heels. It may also be caused by turning short to the right or left, the foot on the side to which we turn being rather more advanced, and supporting part of the weight.

THE ORDINARY RUN, OR INSIDE EDGE FORWARD.

"The first attempt of the beginner is to walk, and this walk shortly becomes a sliding gait, done entirely on the inside edge of the skate.

"The first impulse is to be gained by pressing the inside edge of one skate against the ice, and advancing with the opposite foot. To effect this, the beginner must bring the feet nearly together, turn the left somewhat out, place the right a little in advance, and at right angles with it; lean forward with the right shoulder, and at the same time move the right foot onwards, and press sharply, or strike the ice with the inside edge of the left skate,—care being taken instantly to throw the weight on the right foot, as seen in fig. 1. While thus in motion, the skater must bring up the left foot nearly to a level with the other, and may for the present proceed a short way on both feet.


Fig. 1.

"He must next place the left foot in advance in its turn, bring the left shoulder forward, inclining to that side, strike from the inside edge of the right skate, and proceed as before.

"Finally, this motion has only to be repeated on each foot alternately, gradually keeping the foot from which he struck longer off the ice, till he has gained sufficient command of himself to keep it off altogether, and is able to strike directly from one to the other, without at any time having them both on the ice together."

THE FORWARD ROLL OR OUTSIDE EDGE.

This is commonly reckoned the first step to figure skating, as, when it is once effected, the rest follows with ease. The impulse is gained in the same manner as for the ordinary run; but, to get on the outside edge of the right foot, the moment that foot is in motion, the skater must advance the left shoulder, throw the right arm back, look over the right shoulder, and incline the whole person boldly and decisively on that side, keeping the left foot suspended behind, as shown in our illustration, fig. 2.

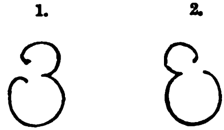
As he proceeds, he must bring the left foot past the inside of the right, with a slight jerk, which produces an opposing balance of the body; the right foot must quickly press, first on the outside of the heel, then on the inside, on its toe; the left foot must be placed down in front, before it is removed more than about eight or ten inches from the other foot; and, by striking outside to the left, giving at the same moment a strong push with the inside of the right toe, the skater passes from right to left, inclining to the left side, in the same manner as he did to the right. He then continues to change from left to right, and from right to left, in the some manner. At first he should not remain long upon one leg, nor scruple occasionally to put the other down to assist; and throughout he must keep hlmself erect, leaning most on the heel.

Fig. 2.

FIGURE OF THREE, OR INSIDE EDGE BACKWARDS.

This figure is formed by turning from the outside edge forward to the inside edge backward on the same foot. The head of the 3 is formed like the half circle, on the heel of the outside edge; but when the half circle is complete, the skater leans suddenly forward, and rests on the same toe inside, and a backward motion, making the tail of the 3, is the consequence. The figure described by the right leg should be nearly in the form of No. 1; and on the left leg should be reversed, and resemble No. 2.

1. 2.



At first the skater should not throw himself quite so hard as hitherto on the outside forward, in order that he may be able the more easily to change to the inside back. He may also be for some time contented with much less than a semicircle before he turns. Having done this and brought the left leg nearly up to the other, he must not pass it on in advance, as he would to complete a circle, but throw it gently off sidewise, at the same moment turning the face from the right to the left shoulder, and giving the whole person a slight inclination to the left side. These motions throw the skater upon the inside of his skate; bnt as the first impulse should still retain most of its force, he continues to move on the inside back, in a direction so little different, that his first impulses loses little by the change. (Fig. 3.)


Fig. 3.

If unable to change the edge by this method, the skater may assist himself by slightly and gently swinging the arm and leg outward, so as to incline the person to a rotatory motion. This swing, however, must be corrected as soon as the object is attained; and it must generally be observed that the change from edge to edge is to be effected merely by the inclination of the body, not by swinging, a practice boys are apt to indulge in.

OUTSIDE EDGE BACKWARDS.

Here the skater, having completed the 3, and being carried on by the first impulse, still continues his progress in the same direction, but on the other foot, putting it down on its outside edge, and continuing to go backwards slowly.


Fig. 4.

To accomplish this, the skater, after making the 3, and placing the outside edge of his left foot on the ice, should at once turn his face over the right shoulder, raise his right foot from the ice, and throw back his right arm and shoulder. (Fig. 4.)

Such are the four movements of which alone the skate is capable: namely, the inside edge forward; the outside forward; the inside back; and the outside back; in which has been seen how the impulse for the first two is gained. and how the third flows from the second, and the fourth from the third. By the combination of these elements of skating, and the variations with which they succeed each other, are formed all the evolutions in this art.

SWIMMING.

In swimming great caution is required in the commencement, for it is too often a failing in youth to tempt danger and incur risks, often fatal, from not having acquired the knowledge of averting them.

EFFECTS OF BATHING ON THE HEALTH.

Cleanliness, obtained in whatever way, keeps open the pores of the skin, and allows of the free escape of the insensible perspiration, which is thrown off in great quantities, and the free egress of which is of the utmost importance to the health of the system.

The tonic and reviving qualities of cold water are of the most remarkable character. How wonderfully refreshing it is to bathe merely the face and hands in cold water.

On first plunging into cold water, there comes a shock which drives the blood to the central parts of the system. But immediately a reaction takes place, which is assisted by the exercise of swimming, producing, even in water of a low temperature, an agreeable warmth. The stay in the water should never be prolonged beyond the period of this excitement. If the water be left while this warmth continues, and the body immediately dried, the healthy glow over the whole surface will be delightful.

To remain in the water, after the first reaction is over, produces a prolonged chilliness, a shrinking of the flesh, and a contraction of the skin, by no means favourable to health or enjoyment; for it is only in water thoroughly warmed by the summer heats, where we may bathe for many hours with impunity.

Certain precautions are necessary. Moderate exercise, by summoning into action the powers of the system, and quickening the circulation, is better than inactivity, We should never go into water immediately after a meal, nor while the process of digestion is going forward. Nor should we plunge into the water when violently heated, or in a state of profuse perspiration. Such imprudences are often fatal, especially if the water be unusually cold. If too warm, the temperature of the body may be reduced by bathing the wrists, and wetting the head.

TIMES AND PLACES FOR SWIMMING.

Before meals rather than after, and especially before breakfast, and before supper, are proper seasons for bathing. The heats of the day are to be avoided, but, in very hot weather, a bath is useful to cool the blood, and secure refreshing sleep. If, in the middle of the day, a shaded place should be chosen, or the head protected from the sun by being kept wet, or by wearing a straw hat, as is practised by the fashionable French ladies at their watering-places.

The sea is the best place for swimming. Owing to the greater specific gravity of salt-water than fresh, the body is more buoyant in it, as are other substances. A ship coming out of salt-water into fresh, sinks perceptibly in the water. The difference is nearly equal to the weight of the salt held in solution.

The bottom should be of hard sand, gravel, or smooth stones. Sharp stones and shells cut the feet—weeds may entangle them. The swimmer must avoid floating grass and quicksand. The new beginner must be careful that the water does not run beyond his depth, and that the current cannot carry him into a deeper place, also that there be no holes in the bottom. As persons are ever liable to cramps, accidents, &c., it is always best that boys or girls should be accompanied by those who are older than themselves, and who will be able to save them in any emergency.

AIDS IN LEARNING TO SWIM.

Probably one of the best ways of learning to swim is to go, with a competent teacher, in a boat in deep water, this supporting the body more buoyantly than that which is shallower, and preventing the constant tendency of beginners to touch the bottom, which here is of course impossible.

The teacher should fasten a rope carefully around the waist, or, better still, to a belt, which can neither tighten nor slip down. The rope may be fastened to a short pole. Supported in this manner, the pupil may take his proper position in the water, and practise the necessary motions, and the support of the rope may be gradually lessened, until the pupil finds himself entirely supported by the water.

Corks and bladders are often used as supports for learners; but it is much better to begin without them. As, however, they may be a protection in some cases against accidents, and enable the learner to practise the motions for rapid swimming more carefnlly, they are not to be entirely condemned. Several large pieces of cork, uncut into stopples, must be strung upon each end of a piece of rope, long enough to pass under the chest, and reach just above the shoulders; or well blown and properly secured bladders may be fastened in the same way. Care must be taken to confine these supports near the shoulders, as by their slipping down they would plunge the head under water, and produce the very catastrophe they were especially designed to prevent.

A great variety of life-preservers have been invented, made of India-rubber and cork-shavings, in the form of jackets, belts, &c., which may be used like the corks and bladders; but as their bulk is generally all around the chest, they hinder the free use of the arms, and impede the velocity of motion. As life-preservers, they would do very well if people ever had them on when they were needed, or had presence of mind enough to fit and inflate them in sudden emergencies. The best life-preservers are the self-reliance and well-directed skill of a good swimmer.

Swimming with the plank has two advantages. The young bather has always the means of saving himself from the effects of a sudden cramp, and he can practice with facility the necessary motions with the legs and feet, aided by the momentum and plank. A piece of light wood, three or four feet long, two feet wide, and about two inches thick, will answer very well for this purpese. The chin may be rested upon the end, and the arms used, but this must be done carefully, or the support may go beyond the young swimmer's reach.

A better method, as many think, than any of these, is for the teacher to wade into the water with his pupil, and then support him in a horizontal position by placing his hand under the pupil's chest, while he directs his motions. He may withdraw his support almost imperceptibly; but I do not see what advantage this method has over that first noticed with the boat, unless it be that the teacher can better enforce his precepts by examples, and in swimming himself, give practical illustrations of his theories of propulsion.

The rope is another artificial support which has its advantages. A rope may be attached to a pole, fastened—and mind that it be well fastened—in the bank, or it may be attached to the branch of an overhanging tree. Taken in the hands, the swimmer may practice with his legs, or by holding it in his teeth, he may use all his limbs at once. The rope, however, is not so good as the plank, as it allows of less freedom of motion; and the latter might easily be so fixed as to be laid hold of by the teeth, and held securely.

THE CRAMP.

Those persons who plunge into the water when they are heated by exercise, and remain in it until they are benumbed with cold, or exhaust themselves by very violent exertion, are the most subject to attacks of cramp. The moment the swimmer is seized by cramp in the legs he must not suffer himself to feel alarmed; but strike out the limb with all his might, keeping the heel downward, and drawing the toes as far upward as he can, although at the time these movements give him great pain; he may also turn on his back, and jerk the limb into the air, though not so high as to throw himself out of his balance. Should these attempts prove unsuccessful, he must try to reach the shore with his hands; or, at all events, keep himself afloat until assistance can be procured. If he cannot float on his back, he may swim upright, keeping his head above the surface, by striking the water downward with his hands near his hips; and thus make steady progress without using his legs. If only one leg be attacked, the swimmer may strike forward with the other; and to acquire confidence in cases of cramp, it is advisable to practise swimming with one hand and leg; with the hands only, or even with one leg.

ENTERING THE WATER.—STRIKING OUT.

We now come to the most important directions. As the pupil must gradually acquire confidence in this new element, he should not be urged to plunge in against his inclination. After wetting his head, he may wade in until the water is up to his breast, then, turning towards the shore, inflate his lungs and incline forward, until the water covers his chin. The head should be thrown backward, and the back hollowed, and the chest as much as possible expanded. In swimming the feet should be about two feet below the surface. The hands should be placed in front of the breast, pointing forward, the fingers kept close together, and the thumb to the fingers, so as to form a slightly hollow paddle. Now strike the hands as far as possible, but not bringing them to the surface; then make a sweep backward to the hips, the hands being turned downward and outward: then bring them back under the body, and with as little resistance as may be, to their former position, and continue as before.

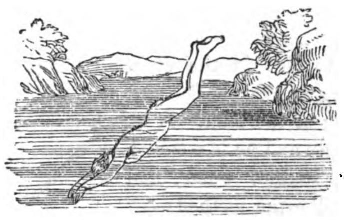
The hands have three motions:—First, from their position at the breast, they are pushed straightforward; second, they sweep round to the hips, like an oar, the closed and hollowed hands being the paddle portion, and their position in the water and descent serviug both to propel and sustain the body; and, third, they are brought back under the body to the first position.

Having learned these motions by practising them slowly, the pupil should proceed to learn the still more important motions of the legs. These are likewise three in number—one in preparation, and two of propulsion. First, the legs are drawn up as far as possible, by bending the knees, and keeping the feet widely separated; second, they are pushed with force backward and forward, so that they spread as far as possible; and third, the legs are brought together, thus acting powerfully upon the wedge of water which they enclose.

The motion in the water should be as straightforward as possible, and the more the head is immersed the easier is the swimming. Rising at every stroke—*breasting*, as it is called—is both tiresome and inelegant. If he draw in his breath as he rises, and breathe it out as he sinks, he will time his strokes, and avoid swallowing water.

PLUNGING OR DIVING.

In leaping into the water, feet first, which is done from rocks, bridges, and even from the yards and masts of lofty vessels, the feet must be kept close together, and the arms either held close to the side or over the head. In diving head foremost, the hands must be put together, so as to divide the water before the head, The hands are also in a proper position for striking out.



It is wonderful how easy the swimmer directs his course under water. If he wishes to go down or come up, or swim to the right or left, he has but to bend his head and body in that direction, and after a little use he will do this almost unconsciously, as if his movements were the result of volition alone.

In descending in the water, bend the head so as to bring the chin near the breast, and curve the back in the same direction; in ascending, hold back the head and hollow the back. In swimming over the surface, he should look up to the sky.

In the flat plunge, which is used in shallow water, or where the depth is unknown, and which can be made only from a small height, the swimmer must fling himself forwards, in order to extend the line of the plunge as much as possible under the surface of the water; and, as soon as he touches it, he must keep his head up, his back hollow, and his hands stretched forward, flat and inclined upward.

SWIMMING IN DEEP WATER.

In the swimming schools of Prussia the pupils are taught in deep water, sustained by a belt, and a rope attached to a pole, which the teacher holds as a lever over a railing. The motions of the arms, then of the legs, and then both together, are practised by word of command, like military exercises. The support is given as required. After a few lessons the pole is dispensed with—then the rope; but the pupil is still kept, until proficient, within reach of the pole.

This mode of learning to swim is like that practised in teaching boys to ride in the circus. A rope, fastened to a belt, passes through a ring in the saddle, and the end is held by the riding-master in the centre of the ring. If the boy falls, his teacher has only to draw upon the ropes and he is secure from danger.

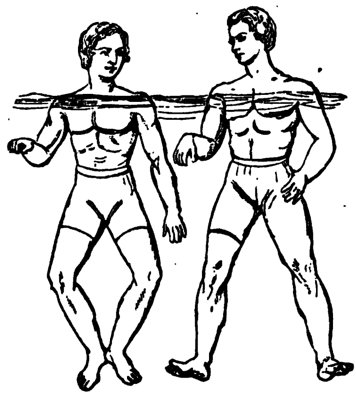
Those who are learning to swim in shallow water, and without a teacher, may find an advantage in the following method:—

When the learner has acquired some facility in swimming, and wishes to try to swim out of his depth, he should first venture to cross a stream which may be a foot or two overhead in the middle. He must not be alarmed at not feeling ground under his feet, or make quick and short strokes, and breathe at the wrong time, so that he involuntarily swallows water; all which mishaps, of course, increase the hurry and agitation, and make it difficult for him to get back to shore.

In the deep plunge, which is used where it is known that there is depth of water, the swimmer has his arms outstretched, his knees bent, and his body leant forwards till the head descends nearly to the feet, when the spine and knees are extended. This plunge may be made without the slightest noise. When the swimmer rises to the surface, he must not open his mouth before previously repelling the water.

TREADING WATER.

This is a favourite position in the water, and useful as a means of resting in swimming long distances. The position is perpendicular; the hands are placed upon the hips, or kept close to the side, to assist in balancing the body, being moved like fins at the wrist only. The feet are pushed down alternately, so as to support the head above water; and the body may be raised in this way to a considerable extent. While in this position, if the head be thrown back so as to bring the nose and mouth uppermost, and the chest somewhat inflated, the swimmer may sink till his head be nearly covered, and remain for any length of time in this position without motion, taking care to breathe very slowly.



There is, however, another mode of treading water, in which the thighs are separated, and the legs slightly bent, or curved together, as in a half-sitting posture. Here the legs are used alternately, so that, while one remains more contracted, the other, less so, describes a circle. By this method, the swimmer does not seem to hop in the water, but remains nearly at the same height.

UPRIGHT SWIMMING.—SYSTEM OF BERNARDI.

Bernardi, an Italian teacher of swimming, who has written a treatise upon the subject, warmly recommends the upright position in swimming as being in conformity with the accustomed movements of the limbs; from the freedom of the hands and arms, greater facility of breathing, and less risk of being caught hold of by persons struggling in the water.

Though this method can never supersede that taught by nature, and the frog, her best professor, it may be practised for variety's sake. The great difficulty is in keeping the head properly balanced, for whichever way it inclines, over goes the body.

SIDE SWIMMING.

In swimming on either side, the motions of the legs have no alteration, but are performed as usual. To swim on the left side, lower that side, which is done with the slightest effort, and requires no instructions.

Then strike forward with the left hand, and sideways with the right, keeping the back of the latter to the front, with the thumb side downward, so as to act as an oar. In turning on the other side, strike out with the right hand, and use the left for an oar. To swim on each side alternately, stretch out the lower arm the instant that a strike is made by the feet, and strike with the other arm on a level with the head at the instant that the feet are urging the swimmer forward; and while the upper hand is carried forward, and the feet are contracted, the lower hand must be drawn towards the body. This method is full of variety, and capable of great rapidity, but it is also very fatiguing.

THRUSTING.

This is a beautiful variety of this exercise, and much used by accomplished swimmers. The legs and feet are worked as in ordinary swimming, but the hands and arms very differently. One arm—say the right—should be lifted wholly out of the water, thrust forward to its utmost reaching, and then dropped upon the water with the han hollowed, and then brought back by a powerful movement, pulling the water toward the opposite armpit. At the same time the body must be sustained and steadied by the left hand, working in a small circle, and as the right arm comes back from its far reach to the armpit, the left is carrying in an easy sweep from the breast to the hip. The left arm is thrust forward alternately with the right, and by these varied movements great rapidity is combined with much ease.

SWIMMING ON THE BACK.

This is the easiest of all modes of swimming, because in this way a larger portion of the body is supported by the water. It is very useful to ease the swimmer from the greater exertion of more rapid methods, and especially when a long continuance in deep water is unavoidable. The swimmer can turn easily to this position, or if learning, he has but to incline slowly backward, keeping his head on a line with his body, and letting his ears sink below the surface. Then placing his hands upon his hips, he can push himself along with his feet and legs with perfect ease, and considerable rapidity.

The hands may be used to assist in propelling in this mode by bringing them up edgewise towards the armpits, and then pushing them down, the fingers fronting inward, and the thumb part down. This is called "winging."

The hands may be used at discretion, the application of force in one direction of course giving motion in the other; and the best methods are soon learned when once the pupil has acquired confidence in his buoyant powers.

KITE FLYING.

We purpose to give our boys a little assistance in kite-making and kite-flying; but young friends, remember, that the wisest man says—"there is a time for work," as well as a "time for play," and do not therefore abuse your liberty by idleness, but "work while you work, and play while you play"

Kites afford excellent amusement, both in making and flying them. Our own boys have one upwards of six feet high, with a tail sixty feet long. When the wind is favourable we are accustomed to employ thi kite in towing a boat on the Thames. In a strong breeze we are drawn along with great rapidity and steadiness, even up stream. A kite of such a size requires very strong string or small cord to fly it, as it pulls so that one person cannot hold it. When it is mounted we usually fasten the cord to a gate or post. The kites that are bought at shops are poor things. It is much better that boys should make their own; this affords an exercise of their ingenuity, as well as an amusement. A lath called a *straighter*, must be procured, four feet long, an inch wide, and a quarter of an inch thick. The *bender* must be a cane or hoop planed thin at the edges, and should be of the same length as the straighter. Tie the cane firmly on the end of lath, as at A in figure 1; bend down the ends C and D, and fasten them in the bent position by strings passing from the points as shown, where notches must be cut, in order that the string may not slip on being tied.

When this is done the frame of the kite is completed. The best thing to cover it with is thin glazed calico, as it may be put on all in one piece. If

Fig. 1.

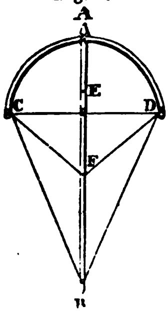
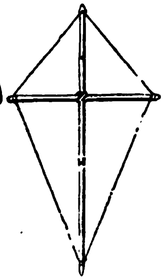


Fig. 2.



paper is used, the sheets must first be pasted together with the edges lapping over each other about half an inch. Lay the frame on the calico or paper, cut it out to the shape, leaving an inch to be turned over and pasted to the frame. Some small pieces must then be pasted over the lath and the strings at the back to keep it secure in the middle. Two holes must be made in the straighter at E and F, through which a piece of strong string is to be put, and fastened at the end with a knot, to keep it from coming through the holes. This is called the *belly-band.* The string to fly the kite with is to be tied to this belly-band; care must be taken to tie it in the right place, if it be too low, the kite will turn round and round in the air, if too high, it will plunge about and pitch. A little experience will soon teach the proper place to fasten it. The tail should be at least ten times as long as the kite. It is much better not to have slips of paper tied into it, but only a *bob* at the end; that is, a large tassel made of paper cut into fringes, and sufficiently heavy to keep the kite in its true position in the air. Tails made with slips are nearly always trouble-some from getting entangled; and, as the wind shakes them more than it does a plain string, the kite is not so steadily balanced.

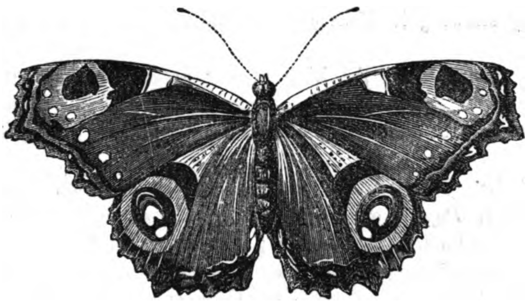
When the kite is flying you may send up a *messenger*, which is a round piece of paper, or card-board with a hole in the middle, this is put on the string, and the wind soon carries it up to the kite.

A hollow tube of paste-board, with four little sails attached, forms another kind of messenger. The sails are to be made of coloured paper, similiar to the little wind-mills often sold in the streets. When the tube is placed on the string, the wind acting on the sails, causes the messenger to rotate or spin round; and this, as it ascends, forms a pretty object.

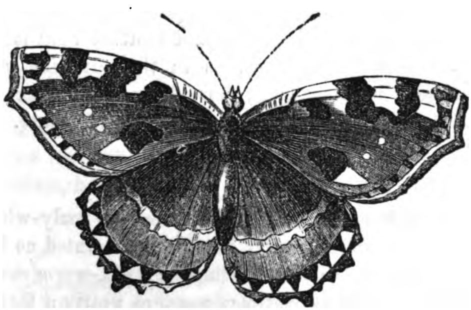
Kites are frequently made of other shapes. Fig. 2, is another form, which is called a *drake;* but that we have described Fig. 1 is the best in form, as well as for flying.

BRITISH BUTTERFLIES.

The origin of the word Butterfly is Saxon, *Butter-fleoze*, so called because they were thought to be most plentiful in the season when butter was so. The butterfly belongs to the *lepidopterous* order of insects; this is a Greek word, signifying scaly-winged, their wings being covered



with fine silky scales, or feathers as they are often called. Naturalists call these flies *Diurnal Lepidoptera*, because they come out in the day time only. *Papilio* is a term, also, sometimes applied to them; this is the Latin for a butterfly, which undergoes three changes or transforma-



tions; from the egg to the caterpillar or *larva;* from that to the *chrysalis* or *pupa;* and from that to the perfect fly or *imago;* two of these are Latin words, the first signifying a mask, and the third an image;

the second is Greek, and comes from *chrysos* golden, in reference to the shining metallic specks which are seen on several of the pupa cases, or chrysalides, as they are termed in the plural.

Of British butterflies we have upwards of 70 species, many of which are very beautiful, although not so much so, nor nearly so large, as some of the foreign kinds. About the largest is the Swallow-tail, found chiefly in fenny districts; the Camberwell Beauty is also large and very rare, only showing itself at considerable intervals of time, often some years.

By common consent the king of our native species is the Purpl Emperor (*P.* or *Apturo Iris*), a glorious fellow that flies high up among the oak-tops, with a rich purple sheen on his velvety wings, like a regal mantle.

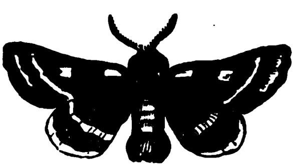
One of the most beautiful is the Peacock Butterfly, (fig. 1.) naturalists call it *Papilio* or *Vanessa Io*. Old writers termed it *Omnium Regina*, Latin for the Queen of all; it is not a rare fly, especially in the southern parts of Britain, and may be seen in every collection; as may also the Red Admiral, *Papilio* or *Vanessa Atalanta*, seen generally about August and September; this is a magnificent insect. The White Admiral, *Papilio* or *Limenitis Camillæ*, is more sober coloured, and more rare; but rarer yet is the large Tortoiseshell *P.* or *V. Polychlorus* Greek for many coloured, a glorious insect, (fig. 2.)

The Small Tortoiseshell (*P.* or *V. Urtica*), the latter word being th Latin for the nettle, on which the caterpillar feeds, is common enough; and white and marbled and brown, and mottled Fritillaries, and little azure flies, flit and flutter about us in the sunshine in abundance; while the summer weather lasts, furnishing similes for the poet, the moralist, and delight for the child and the lover of nature.

BRITISH MOTHS.

Moths, like Butterflies, are Lepidopterous or scaly-winged insects; the naturalist, Lewenhoeck, states that he has counted no less than *four hundred thousand scales* upon the wings of a silk-worm moth, and there are foreign moths which sometimes measure nearly a foot across: how many scales must there be on their wings? Our largest native moth is the Death's Head; so called from its singular markings, which somewhat resemble a scull and cross-bones. This is one of the Hawk moths or Sphinxes, of which we have several, all large and handsome, very stout in the body, which stoutness is one of the most evident distinctions between the moths and butterflies generally. The former are termed *Nocturnal* or *Crepuscular* Lepidoptera, because they fly mostly after sunset, in the twilight or deeper gloom of the silent season. The colours of these insects are more subdued than those of the butterflies and we see here an evidence of divine wisdom; they are not meant for the broad sunshine. It would please u well to enter more fully into the history of moths, and describe the various species, but at present a mere indication of the great divisions represented in Britain must suffice. 1st, then we have the *Hesperidæ*, which, contrary to moth-nature in general, fly much by day; in this group are included the Skipper, and some others; they are all small, and mostly brown and dull yellow of various shades. In the *Crepusculæ*, or twilight division, we have the little Green Forrester, and peculiarly formed Burnet moths, also the Sphinxes above-mentioned, and many others, divided into several genera, with the Latin names of which we need not trouble our readers. As an example of this class, certainly an humble one, we give the little Lackey moth, with its livery of pale buff, turned up with dingy orange.

Some naturalists, however, place this with the *Nocturnal* Lepidoptera, the largest class of all, in which we find the Emperor, which rejoices in the name of *Saturna Pavonia minor*, and is the most beautiful of the British species. Here, too, we have the brilliant Tiger moth, the Kentish Glory, and a host of others, among which is the Oak Egger with his dress of silky buff and yellow, relieved with white.



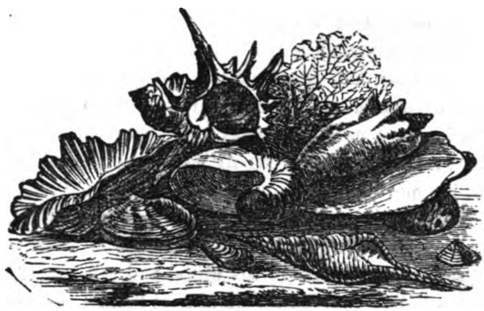
At the head of this article we give a cut of a species new to this country, the *Spatalia bicolora*, lately discovered in Ireland, near the Lakes of Killarney; it is chiefly white, with orange-brown spots on the upper wings, these spots being edged here and there with black, setting off the pure white of the insect charmingly. The caterpillar is hairy, of a deep green; it feeds on the birch, and is not uncommon in some parts of France and Germany, although no specimen has yet been discovered here, and only *one* of the moth.

The moth is a pretty, yet formidable enemy in a house. In all woollen manufactures, blankets, flannels, moreen curtains, carpets, as well as in furs, and amidst feathers, it seeks to form its nest and to deposit its eggs; whence in the spring of the year issue the larvæ which from such substances derive nourishment. In this stage of the insect's existence the ruin takes place of the fabrics upon which it feeds. This is visible in the innumerable small circular holes through which it has eaten, and which, destroying the strength and tenacity of the material render it worthless.

Many persons suppose that moths are produced in clothes that are laid by, merely by their being shut up in closed places; but this is an error. None of the little larvæ or caterpillars of the moth, that really do the mischief, ever appear among clothes or articles of any kind, provided none of the winged moths can have access to them to lay their eggs there, for no insects can be engendered otherwise than by the usual method of propagation. The winged moth, that flies about in the dark, does not, cannot, eat or destroy cloth of any kind; but lays its eggs in woollen articles, upon which alone nature dictates to her that her young must feed. These eggs in time produce little caterpillars, and it is they that eat holes in and destroy clothes, &c. After a time these caterpillars assume the pupa state, out of which burst forth the winged insect, to proceed, as before described, in laying eggs. From this account it is easy to see that, provided you can prevent the winged moth from having access to what you wish to preserve, no injury by moths can happen to them. For instance, if you tie up any article that is quite free from moth in a bag of linen, cotton, or paper, no winged moth can enter the bag to lay its eggs; and therefore the bag will be a perfect security. But it is to be observed the winged animal is very cunning, or rather instinct impels it to search with great care for suitable places to lay its eggs; and therefore, simply putting things into drawers, however tight, or covering them over with paper, will not be sufficient: if there are chinks by which the winged animal can insinuate itself, such places will not be safe from moths.

Nature has likewise given the instinct to moths, not to lay their eggs in places liable to be often disturbed: therefore, if you shake any articles very frequently, it is not likely that moths will deposit their eggs there; and if not, there can be no caterpillars to do mischief.

GARDEN WORTHIES.



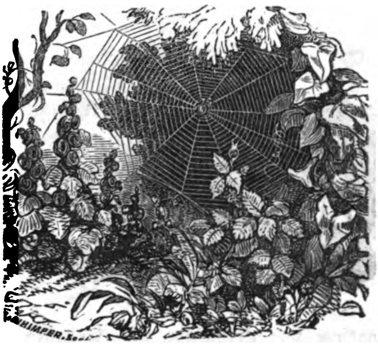
THE SNUG OLD GENTLEMAN.

THIS is a personage of very retired and quiet habits, who has never at any time made a noise in the world, and yet whom we cannot become acquainted with without feeling for him respect and interest. He is proverbially *slow;* and yet, if people would only think so, it is much better to be slow in his kind of way, than to be *fast* in another sense. He always stays at home, and was never on any occasion known to pay a visit from his own house—which is strange, because some near relations of his have no houses at all! His house is most curiously contrived —spiral in fact, with a wide entrance, (for the old gentleman is rather stout), and has no door; but when he wants to be snug, he has only to bring his house (for it is moveable) up to the garden wall or the trunk of a tree, and he can fix it against it in such a manner, that the entrance is closed up as completely as if it had a dozen doors. The old gentleman is not at all rheumatic, for he likes damp weather better than dry, and when the evening dews fall, or just after a shower, he will sally forth—we fear we must say *creep* forth—to dine or sup off a cabbage, or a lettuce; for he is a strict vegetarian and has very much the same taste in vegetables as ourselves. The strangest thing of all, however, about this individual is his house;—how from infancy to old age its owner contrives to increase it in proportion as his own body increases. It is formed of a sort of mortar, made half of lime and half of a kind of animal glue, and of this—always keeping to the original spiral plan, he adds from time to time, tiny additions, always to the *edge* of the entrance—or in other words, to his door-posts, which, soft at first, harden in the air until the new part is as strong as the old. When the master of the house has attained maturity and has done growing, he then finishes off the entrance of his house most neatly, rounding it off with a kind of cornice, and then making the whole house so solid with additional coats of plaster inside, that a toss over the garden wall will not disturb its inmate; or even should its walls get a crack, the owner, being his own mason, can easily repair the damage with a few layers from within of his mortar.

With our old friend's love of retirement, it is very difficult, I must say, to get a glimpse of himself, though his house is often seen. Rude children will sometimes knock at his walls, and tell him if he does not "come out of his hole," they will beat him as "black as a coal." But instead of doing this, only watch your opportunity when the old gentleman is going to his dinner, or taking a walk, and you will be sure to admire his stately and dignified pace, his soft skin and searching eyes—even if you cannot manage to pick up any of the silver he scatters in his path as he goes along, you will have plenty of time to look at him; for he is certainly slow—*very* slow!

THE NIMBLE WEAVER.

In a remote corner of the garden lives a most ingenious and industrious little weaver. It is quite worth your while to find him out, if only for the sake of admiring his web. Nothing could be more delicately or more skilfully woven; and if you should chance to see it on a dewy morning when the sun is shining on it, you will find it adorned with tiny pearls and diamonds, quite equal to the Queen's wedding dress, or the robe she puts on to open her Parliament in. We must not lead you into the error, however, of supposing that its maker is a weaver by trade. On the contrary, he is an independent gentleman who merely weaves these webs, or rather *nets*, for his own sporting purposes. He lives, in fact, entirely on game caught in his own nets. He makes one of these webs, spreads it out where plenty of game is to be had, retires on one side, and waits patiently till his prey is entangled in it, and then darting out he seizes it, kills it, and eats it. All this is



very clever; and our sportsman, in encounters with fierce creatures, larger even than himself, will, after a good tussle with them, almost always come off victorious. But what we would have you observe, is the extraordinary manner in which these game nets are formed. Attached to his body, the nimble weaver has four little bags of thread, and in these bags are thousands of tiny holes, out of which come the tiny threads, which, as they run out, are spun together and make one thread. Strong though delicate is it, for it will easily support the weaver's own body; and should he happen to want to go down stairs, he never thinks of walking, for he has only to let himself down by his rope from whatever height he may be, and when he wants to return, haul himself up by it again. A thousand holes are in each bag—so out of these four bags 4000 threads come out as he runs to make up the—great thick cable! No: to make up the exquisitely fine delicate line with which our wonderful weaver weaves his web!

MADAM CHANGEABLE.

This is a very fine lady! When we first know her and her companions in their early life, we cannot but observe the great variety of colours and patterns that they wear, and this peculiarity is observable also in after life. The lady I particularly speak of, has a great partiality for yellow, especially stripes and spots of yellow alternately with brown and green and white. She is to be seen in the garden in summer walking along very daintily, and even gracefully, generally preferring

the cool shade of foliage to the glare of the sun. She changes her outer garments two or three times in a season, but the new one is always of the same pattern and colours as the old, until she all at once retires from public life—chooses some very retired corner—wraps herself up in a plain brown suit, and falls into a sort of half-torpid state, as if quite disgusted with the world, neither eating nor drinking, nor walking abroad. At this time, too, she changes her name. You might fancy that all this was the result of old age, and that, beginning to prepare for her end, she had made up her mind to retire from the bustle and vanities of life, and give herself up to reflection and meditation; but no such thing! Madam Changeable is all this time only preparing for a return to life more gay, more volatile, and more of the fine lady than ever. On some fine sunny day she comes forth again, and nothing can be more devoted to pleasure than she becomes. Her dress is as gaudy as possible, and of the most delicate texture, and quite of a different fashion in cut and form to what she wore when young. If not all of a bright yellow, it will be spotted with colours as brilliant as the rainbow, and again assuming a new name, she adopts one which all over the world is but another name for frivolity and gaiety. Some of her family do, it is true, wear sober brown garments, but in spite of looking graver, will be as fond of fluttering about as their gaudier sisters. The only purpose of their life seems to be feeding on sweets and displaying their finery in the sunshine:—but not to do them injustice, we must confess, that they *do* perform one of the duties of life. They take into consideration the future well-being of their children, and before they end their lives of dissipation, take care to place their offspring in such situations as will secure their future maintenance and support; and then they die, and nothing more is seen of Madam Changeable, unless it should happen that some one should have taken a great fancy to the last dress she appeared in, and instead of letting her die a natural death, seized her and stuck a sharp spear through her body, and putting her into a glass case, sent her to be exhibited in a museum of curiosities!

THE SMALL MEMBER OF A LARGE COMMUNITY.

This little personage is one of whom it is difficult to speak, because his life and interests are so wrapped up in those of the society he belongs to that he seems never to think of himself, and to have no object in life but the good of the whole community. We never heard of one of his family who set up for himself in business, or who lived apart from others. We talk of the population of our large towns, but that is nothing to the numbers which people the communities of which our little friend is a member. They do not live at our antipodes, and yet they do live beneath our feet in another way, in subterranean cities so overflowing with inhabitants, that it is quite difficult to imagine how they all find food. The little creatures have, however, each his part to perform, and each does it well. Some spend their lives in hollowing out apartments, galleries and passages leading to them, making cuttings and raising up embankments. They work incessantly. Some rear the young, others collect food and lay it up in store-houses. You take a walk in your garden, and not observing where you tread, you crush in with remorseless indifference a splendid piece of embankment, which it had taken thousands of these little people the whole of a sunny morning to construct—a period of time which forms a considerable part of their lives. *You* never saw or knew that beneath the turf of that lawn is a grand buried city, not so much unlike one of those that Dr. Layard found on the banks of the Tigris, in Assyria—only that this one is still filled with busy, bustling inhabitants. *You* never noticed or knew, that the inhabitants of the city wanted a road made from it across that gravel path and flower border, by which they might make their way to a certain depôt of ripe peaches against that brick wall. Yet two thousand labourers—small *navvies* if you like, or sappers and miners—were set to work to make a magnificent causeway across that path. The grains of sand had to be removed and filed up on each side, so as to form high embankments. If a huge block of flint, or in other words a pebble, came in the way, they must make the road divide so as to pass around it on each side. If such a thing should happen as that a bit of dried leaf or the husk of a seed vessel should be blown across their works, the labourer who first discovers it, runs back in alarm to his fellow-workmen, and announces the disaster with certain signs, and a large detachment of them will go in a body to remove the obstruction. It may be, that the thing that thus lies in their way may be half an inch long, in which case, it will perhaps, take thirty or forty of the labourer many minutes to effect its removal, but somehow or other it is done. And if by chance an enormous man-mountain (yourself for instance) should come striding over that part of the country through which they are making their road, and instead of passing above it, should, with a tremendous thundering, crashing, crunching tread, let fall upon it that branch of the mountain called a foot, the work of thousands durin thousands of seconds will be destroyed! and yet, wonderful and admirable to relate, no sooner will the mountain-man move on, than tens of thousands of the industrious, patient, persevering, never-tiring little people, will instantly crowd to the scene of destruction and ruin, and set to work again to repair the tremendous mischief. The blocks of sand will again be rolled away one after the other; millions and millions of them piled up to form again the steep embankment; the ruins and rubbish will be cleared away; and the causeway once more made free for the safe passage of the tiny inhabitants of the buried city to that fine large, ripe, juicy peach upon the garden wall!

NUTTING.

Those who have passed the spring-time of life may well exclaim, with Coleridge—

"Life went a Maying,
With Nature, Hope, and Poesy,
When I was young.

Who can remember without regret the pleasures of his earlier years? —the sports, the freedom, the exuberance of delight, which accompanies youth?

"Oh, enviable, early days,
When dancing thoughtless pleasure's maze,
To care, to guilt unknown."

The seasons, as they pass fleetly on, bear with them recollections of past enjoyments which it is some relief, in our chequered career, to cherish. With September comes our excursions in the green fields, before cold winds of coming winter have robbed the trees of their freshness—when the clustering fruit of the hazel would tempt our longing palates, and would create as much joy as that which Aladdin experienced in the enchanted cave of precious stones.

Many a "nutting" expedition in the thick woods can we remember! Many a day passed with companions, lightsome and careless as ourselves, in the fastnesses of nature. Surpassingly beautiful is the rich mellowness of Autumn. Bernard Barton thus describes one of its scenes:—

"The bright sun threw his glory all around,
And then the balmy, mild, Autumnal breeze
Swept with a musical and fitful sound
Among the fading foliage of the trees;
And, now and then, a playful gust would seize
Some falling leaf, and like a living thing
Which flits about wherever it may please,
It floated round in many an airy ring,
Till on the dewy grass it lost its transient wing."

But to our subject of "Nutting." Walnuts, we are told, originated in the warm vales of Persia. It is difficult to account for the many ceremonies practised anciently with nuts. They were then thrown in all the avenues leading to the nuptial apartment; before the feet of the passing bride; and the ceremony of strewing the nuts was the conclusion of the wedding day.

Nuts are very useful under different points of view; the threefold advantage which they possess of giving light, warmth, and food, has been combined by Ovid in the following lines:—

> "Nux vigilat, recreat, nutrit, preto igne manuque,
> Pressa, perusta, crepans, luce, calore cibo."

Ovid also has taken notice of the various injuries which the walnut-tree receives at the hands of travellers in the highway; and Boileau says, Ep. vi., speaking of the Seine—

> "Tous ses bords sont couverts de saules non plantés,
> Et de noyers souvent du passant insultes."

Numerous divinations and superstitious practices were formerly done with nuts, particularly about the eve of All Hallows.

There are several varieties of the Hazel, the principal of which are the common hazel and the filbert. The first is a native of every part of Britain, the shells of nuts being found in the bogs even in the coldest parts. The filbert, again, is supposed to be a native of Asia—to have been imported first into Italy, and thence to the rest of Europe. The filbert grows more upright, is more tree-like, and bears larger and better-flavoured nuts than the hazel; but the wood of the hazel is tougher, and the better adapted for hoops, though both make excellent charcoal. There is an American species; and there is also one growing in the vicinity of Constantinople, which bears a nut nearly double the size of the filbert. More than a hundred thousand bushels of foreign nuts are annually consumed in this country.

The common hazel (*Corylus avellana*) has the nut small and short; but the tree grows more easily than the filbert, being found wild not only in forests and commons in England, and especially upon the banks of dingles and ravines, but occurring in extensive tracts in the more northern and mountainous parts of the country. Several places whose soil suits its growth are named after the hazel—such as Hazelmere, Haelburn, &c. The common hazel is seldom cultivated as a fruit tree, though perhaps its nuts are superior in flavour to the others, which are more inviting in size.

The filberts, both the red and the white, and the cob-nut, are merely varieties of the common hazel; and have been produced partly by the superiority of soil and climate where they grow, and partly by culture. The filbert is not thicker than the common nut, but it is at least double the length, and has the kernel large in proportion. The cob-nut is the largest of the species, and it is round. The cluster-nut differs from the others, only in the fruit being produced in large clusters at the ends of the branches. A particular form of tree receives in some parts of the country (especially in Kent, where culture of the filbert is carried on

with advantage) the name of the dwarf productive nut, though that name indicates rather the mode in which the tree is trained than the variety to which it belongs. Generally speaking the filbert is but a low grower; but still considerable ingenuity is exerted in keeping it down, it having been found by general experience that the dwarfing of fruit trees is the most effectual means of insuring a large and uniform crop and fruit of a superior quality. The trees that are dwarfed are not allowed to exceed seven feet in height; and they are trimmed in the form of a goblet, with an open centre, as is generally done with well-managed gooseberry trees. When the tree comes into proper bearing, this goblet has attained a diameter of about six feet, which is every season covered with filberts, both outside and inside. The nuts are of excellent quality; and it is found, by comparison, that a tree treated in this manner, with the ground regularly hoed and cleaned, will produce more than three which are planted in a hedgerow or coppice, and allowed to run wild in the usual manner.

There is something singular in the flowering of the hazel; the male catkin makes its appearance in autumn, and continues to increase till spring, at which period the process of nature is preparing for the production of the nuts. This takes place as early as February, and before there is yet a leaf on the deciduous trees; so that, besides its advantages as a fruit, the filbert may be regarded as an ornamental tree at that season when groves and coppices have the least beauty.

The word filbert is a corruption of the original English name for this nut, "full-beard," which was applied to the large and fringed husk, to distinguish it from the closer covering of the common hazel. Our old poet, Gower, assigns a more classical origin to the name—

"Phillis
Was shape into a nutte tree,
That all men it might see;
And after Phillis, *Philbert*
This tree was clept."

The Constantinople nut (*Corylus colurna*) is a superior nut to even the best variety of the hazel. Its flavour is equal, and its size is more than double. It is a round nut, invested with a deep calyx, or involucre, which covers it almost entirely, and is very much sloped and fringed at its extremity.

L'Ecluse, a distinguished gardener, brought the nuts of the *Corylus colurna* from Constantinople, in 1582; and Linnæus states, that, in the Botanical Gardens at Leyden, there was growing, in 1736, a fine tree of this species, planted by L'Ecluse. It was cultivated in England by Ray, in 1666. This tree grows naturally in the neighbourhood of Constantinople.

PIC-NIC.

A Pic-nic! What boy cannot recall a happy, joyous day in the woods? A glorious summer day, when with eager step and joyous countenance he wandered forth, his arms laden with homely creature comforts, and his heart thrilling with the treat in store! But the beauty of the morning invites us; let us go forth into the green woods with our social circle, and admire the glorious prodigality of nature. And see, here we are in the depths of the forest. Let us hear what a priestess of nature, Rhoda Maria Willan, can say of the woods and their inmates:—"Yonder is an antlered deer, enjoying his calm slumbers amid the wild fastnesses of Nature! Now, the gorgeous kingfisher, suddenly rising from some hidden spot, sails along between the rushes, scattering a rich light from his painted plumes; and there, the dusky water-hen floats further down the current—her image reflected darkly on its silver, amid the yellow flowers of the water-flag, the noble-looking arrow-head, and the fair and elegant narcissus, which together

> "Gaze on their eyes in the stream's recess,
> Till they die of their own dear loveliness."

How delightful it is to sit in a spot like this—upon the moss-covered trunk of some old tree, forgetting the ungentle world, with all its cares, and exulting only in that deep contented happiness which can look abroad, and say,

> "These bounding prospects all were made for me!"

To linger here in Spring, when the charms of Nature and of beauty are new; to watch the throstle returning to feed her clamorous young, all astir at her approach, but hiding their small heads again when she disappears, and looking, as before, a nest of moveless down; or to notice the young broods, newly fledged,

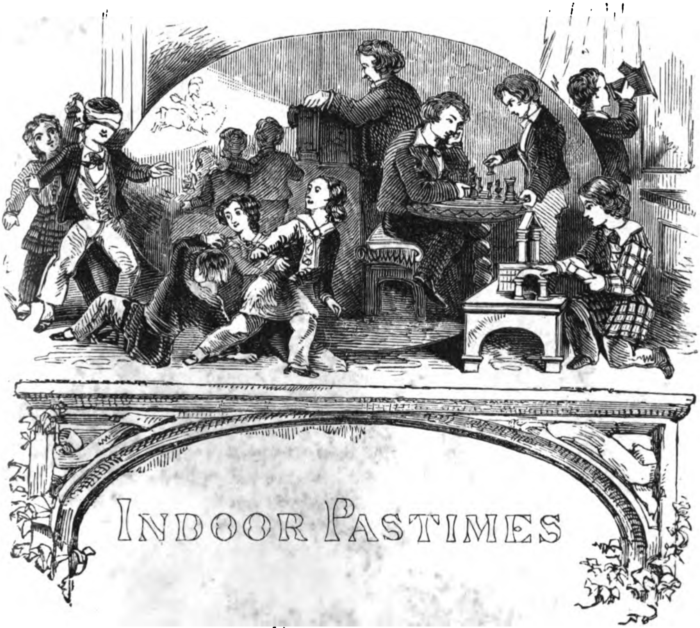
> "First by their nests, hop up and down the hedge;
> Then one, from bough to bough, gets up a tree,
> His fellow noting his agility,
> Thinks he as well may venture as the other;
> So fluskering from one spray to another,
> Gets to the top, and then emboldened flies
> Unto a height past ken of human eyes."

To hear the blackbird singing deep and loud amid the starry clusters of "lush woodbine;" the bullfinch answering sweetly from some distant covert; while the golden-crested wren, scarcely varying in size from one of the leaves by which he is surrounded, shows, now and then, his burnished head amid the greenness, and scatters fairy music around him. At our feet, in the warming verdure, the grasshopper "chithers," and bounds away, green as the land he lives in; while a thousand insects,

instinct with life and song, beat their tiny wings, and shed a many-coloured light upon the ground below.

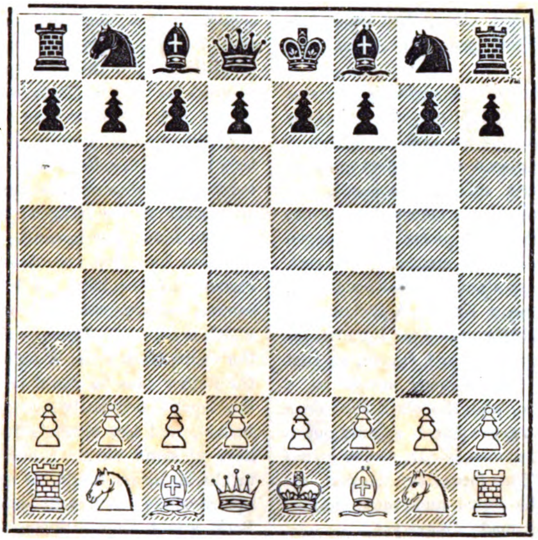
Nothing can be more interesting to the lover of Nature, than to watch the habits of these little creatures, and where they build their homes; all exhibit the same surpassing skill, and show how wonderful are the workings of all-powerful instinct.

THE ILLUSTRATED BOYS' OWN TREASURY OF



CHESS.

BLACK.



WHITE.

CHESS has been correctly described as "highly beneficial to the mind. Nothing in it is governed by chance; judgment is everything. A player, therefore, cannot lay the blame of his losing on fortune, but must ascribe his miscarriages to deficiency of judgment or inattention." With the assistance afforded to beginners in this noble game by the celebrated Herr Harrwitz, it will be possible to become proficients, or at least to play with reflection.

The game of chess is played by two persons upon a board which is square, divided into sixty-four smaller squares. One-half of these sixty-four squares is coloured white, the other half black. The two players sit opposite each other, with the board between them: and care must be taken that a white corner square be at the right hand of each player. When the board is thus placed, the horizontal straight lines, running from right to left, are termed *ranks;* the perpendicular ones running from one player to the other are called *files;* the oblique ranges, of which the two principal ones run from one corner of the board to the opposite one,—one on white, the others on black squares,—and the other adjoining, are named *diagonals.*

Each player has a small army of sixteen men at his command, of which eight are pieces, and the other eight pawns. To distinguish the two armies opposed to each other, they are of different colour, generally black and white.

The names of the eight pieces are as follows:—King, Queen, two Rooks, or Castles, two Bishops, and two Knights. These are placed in the first rank of each player's side of the board, the pawns being placed before them in the second rank. The pieces are arranged in the following manner:—In each corner square stands a Rook, or Castle, next to these a Knight, a Bishop, and the two middle or centre squares are occupied by King and Queen, so that the white King always stands on a black square, and the black King on a white square, the Queen standing on a square of her own colour, *regina servat colorem*. The foregoing diagram represents the board and men, neither side having made a move yet.

MOVEMENT OF THE PIECES AND PAWNS.


KING.

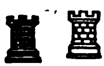
The King can move in any direction, but only to a square adjacent to the one he occupies. He can also capture any adverse man that comes near him unprotected by any other piece or pawn; but he cannot place himself in any square which is attacked by an adverse man, for the King is the only piece that is never taken; he is the soul of the game, and a player may have all his men, and being checked (the meaning of which will be explained hereafter), without being able to remove the attacking or checking man, he is checkmated, that is to say, the game is lost. Though the King can only move one square at a time, there is one exception to this rule, which is only permitted once in a game—that is the act of castling. For this a player has two choices; he may castle to the right or to the left. This is done by moving the King two squares in either direction towards the Rook with which he castles, and placing the Rook on the other side of the King on the square next to him. For instance, supposing white to have his two Rooks in each corner, and the King on his original square, the King can castle on the left, which is called his Queen's side; or on the right, termed the King's side. In the former case he would be placed on the square originally occupied by a Bishop, and the Queen's Rook would have to stand on his Queen's square; in the latter he would be moved to a square where his Knight stood, and his Rook would occupy the square of his Bishop. There are, however, certain conditions attached to the privilege of castling. 1. You cannot castle after having moved your King, or the Rook, with which you wish to castle. 2. There must be no piece between the King and the Rook, whether your own or your adversary's. 3. You cannot castle while in check, nor to a square where the King would be in check; nor can the King castle if, in doing so, he passes a square, which is attacked by an adverse piece or pawn. The two Kings cannot, of course, come close to each other, but must have at least one square between them.

The Queen is by far the most powerful of all pieces, combining the action of the

Rook and the Bishop. It moves in a straight line, rank or file, backwards, and forwards, and also diagonally, but only over empty squares, like all other pieces except one. Place a Queen on the empty board, on the fourth square, counting from the King's square upwards, and thus placed in the centre of the board, she will be found to bear upon twenty-seven squares, exclusive of the one she occupies. Placed in one of the four corners, where her action is most limited, she will still command twenty-one squares besides the one she stands on.

QUEEN.

The Rook, also called Castle, is next in importance to the Queen. It moves in a straight line, backwards or forwards, or sideways, always over empty squares. It is a peculiarity of this piece, that whether it is placed in the middle of the board, or in a corner, it always commands the same number of squares, fourteen, besides the one it stands on.



ROOK.

The Bishop moves diagonally backwards and forwards, as far as the squares are empty. Is never can change its colour, and as each player has two, they are placed, one on a black square, and the other on a white one, the former called the black bishop, the latter the white bishop.

BISHOP.

The move of the Knight is very peculiar, and difficult to describe. The Knight is the only piece that has the privilege to leap over another piece. It moves one square in a straight line, and one obliquely. Thus, for instance, the white Knight, which at the beginning of a game stands to the right of the white King (see diagram), can at once be moved to the third square of the Bishop, or to the third square of the Rook, thus springing over the intervening pawns. This movement, being of a complicated nature, should be practised carefully by the student.

KNIGHT.

The Pawn moves only in a straightforward direction, one square at a time; but, unlike the pieces, which take an adverse man in the same way they move, *the Pawn captures diagonally*. It never moves nor steps backwards. Any Pawn can, on starting from its original place, which, as the diagram shows, is the second rank, make two steps, but in doing so cannot capture an adverse man, but is liable to be taken in passing the intermediate square by an adverse pawn, but not by any piece or officer. For example: your opponent, playing the black, has a Pawn of his on the fourth square, counting upwards from your Queen. You advance your Pawn in front of your King two squares; he has the option of either allowing it to pass or or to take it with his Pawn, as if you had moved it only one square, and in thus capturing your Pawn in passing, he must place his own *on the third square* from your King—*not on the fourth*.

PAWN.

ON TAKING AN ADVERSE MAN.

The art of capturing an adverse man is by removing it from the board and placing your man on the square which the captured piece or Pawn occupied. All the eight men standing in the first rank of the board take in the same direction in which they move; not so the Pawn, which, as stated above, captures diagonally. Any of your men can be captured by an adverse one, except the King: *he is never taken*, but checkmated. The King being, as before mentioned, the soul of the game, each player directs his efforts towards attacking the adverse King, and carefully surrounding his own by his officers and Pawns. Any piece or Pawn attacking an adverse King, is called giving check or checking, and such an attack must be notified by saying. *check;* whereupon your opponent must attend to this immediately, by either capturing the man that thus attacks or checks him, or by interposing some of his men between the checking piece and his King, or lastly by removing his King to another square. But should you be unable to get out of check by either of the above ways, then your King is checkmated,—that is, you have lost the game. Capturing is optional in all cases save one—when your King is in check, and you incapable to move out of check, except by taking the Pawn or piece that checks, you are obliged to do so.

ON THE NOTATION IN GENERAL USE IN THIS COUNTRY.

The way to describe the moves for the purpose of recording games that have been played, or to play a game with some one living several hundred or more miles off, is this:—The squares of the board are named after the pieces which occupy the first rank at the beginning of a game; as, for example, the square occupied by the King is called the King's square; that occupied by the Queen, the Queen's square; the Bishop standing near the King is called the King's Bishop; that standing near the Queen, the Queen's Bishop, and the squares they occupy the King's Bishop's square, the Queen's Bishop's square; and the same with the two Knights and the two Rooks and their squares. The Pawns, which stand before these pieces, take their denominations after them; thus the Pawn standing before the King is called the King's Pawn; that standing in front of the King's Knight, the King's Knight's Pawn; that before the Queen's Rook, the Queen's Rook's Pawn, and so forth. The squares on which the Pawns stand, however, are designated after the pieces in front of which they originally stood; thus the square occupied by the King's Pawn is called the King's second; the one above the King's third, and so on to the eighth. Each player counts from his own side, so that what White calls the King's eighth square, Black would call the King's square. The following diagram gives the double designation of each square:—

It will be seen from the cut that only the initials of the names of pieces are written for the sake of brevity, Kt. standing for Knight. The student should take one piece at a time, and move it about on the board until he becomes quite familiar, both with the moves and the notation; but if he should find any difficulty in retaining the designation of the squares, he may write the names of each of them on a little slip of paper, and paste them on the squares in the manner given above.

Before proceeding any further, the student should be conversant with the technical terms used in Chess, of which the subjoined are the principal, and those of common occurrence.

CHECK.

When a piece or Pawn attacks the adverse King, the latter is said to be in check, and a player thus menacing an adverse King must notify it by saying "check!" whereupon the other player must immediately either move his King to another square, capture the piece or pawn which checks, or cover the check by interposing one of his own men between his King and the adverse man from which the check proceeds. But if he is unable to do either, then the King is *checkmate*, and the game is lost.

BLACK.

Q R's sq. Q R's 8th.	Q Kt's sq. Q Kt's 8th.	Q B's sq. Q B's 8th.	Q's sq. Q's 8th.	K's sq. K's 8th.	K B's sq. K B's 8th.	K Kt's sq. K Kt's 8th.	K R's sq. K R's 8th.
Q R's 2d. Q R's 7th.	Q Kt's 2d. Q Kt's 7th.	Q B's 2d. Q B's 7th.	Q's 2d. Q's 7th.	K's 2d. K's 7th.	K B's 2d. K B's 7th.	K Kt's 2d. K Kt's 7th.	K R's 2d. K R's 7th.
Q R's 3d. Q R's 6th.	Q Kt's 3d. Q Kt's 6th.	Q B's 3d. Q B's 6th.	Q's 3d. Q's 6th.	K's 3d. K's 6th.	K B's 3d. K B's 6th.	K Kt's 3d. K Kt's 6th.	K R's 3d. K R's 6th.
Q R's 4th. Q R's 5th.	Q Kt's 4th. Q Kt's 5th.	Q B's 4th. Q B's 5th.	Q's 4th. Q's 5th.	K's 4th. K's 5th.	K B's 4th. K B's 5th.	K Kt's 4th. K Kt's 5th.	K R's 4th. K R's 5th.
Q R's 5th. Q R's 4th.	Q Kt's 5th. Q Kt's 4th.	Q B's 5th. Q B's 4th.	Q's 5th. Q's 4th.	K's 5th. K's 4th.	K B's 5th. K B's 4th.	K Kt's 5th. K Kt's 4th.	K R's 5th. K R's 4th.
Q R's 6th. Q R's 3d.	Q Kt's 6th. Q Kt's 3d.	Q B's 6th. Q B's 3d.	Q's 6th. Q's 3d.	K's 6th. K's 3d.	K B's 6th. K B's 3d.	K Kt's 6th. K Kt's 3d.	K R's 6th. K R's 3d
Q R's 7th. Q R's 2d.	Q Kt's 7th. Q Kt's 2d.	Q B's 7th. Q B's 2d.	Q's 7th. Q's 2d.	K's 7th. K's 2d.	K B's 7th. K B's 2d.	K Kt's 7th. K Kt's 2d.	K R's 7th. K R's 2d.
Q R's 8th. Q R's sq.	Q Kt's 8th. Q Kt's sq.	Q B's 8th. Q B's sq.	Q's 8th. Q's sq.	K's 8th. K's sq.	K B's 8th. K B's sq.	K Kt's 8th. K Kt's sq.	K R's 8th. K R's sq.

WHITE.

DISCOVERED CHECK,

Is when a player, by removing one man, checks from a piece standing behind it, and which he thus unmasks.

DOUBLE CHECK.

Arises when a player, by removing a piece, gives check by discovery, and at the same time checks also with that piece so moved away. A treble check is impossible.

PERPETUAL CHECK.

Is when a player keeps checking without altering the position, and the game is then given up as drawn.

DRAWN GAME.

Is when neither party can checkmate. This may arise from various causes. From perpetual check; when there is not sufficient force left to effect checkmate, as, for instance, each party having King and Bishop, or King and Knight, and when each party is left with equal force, as each King and Queen, or King and Rook; when a player has King and Rook, or King, Knight, and Bishop, and fails to checkmate his adversary in fifty moves; when both parties persist in making the same moves repeatedly; and lastly, when one of the players is

STALEMATE.

This arises when a player has no piece or Pawn which he can move, and his King being placed in such a position, that he cannot be played to any square without going into check, without, however, being in check. Stalemate is a drawn game.

SMOTHERED MATE.

This is given by a Knight, when the adverse King is so surrounded by his own men that he cannot move, nor take the checking Knight.

SCHOLAR'S MATE.

This can only be effected against a beginner, hence the appellation. It arises from the following moves:—

WHITE.	BLACK.
1. K. P. 2.	1. K. P. 2.
2. K. B. to Q. B. 4.	2. K. B. to Q. B. 4.
3. Q. to K. B. 3.	3. K. R. to P. 1.
4. Q. takes K. B. P.—checkmate.	

THE FOOL'S MATE.

Is even more simple:—

WHITE.	BLACK.
1. K. B. P. 1.	1. K. P. 2.
2. K. Kt. P. 2.	2. Q. to K. R. 5—checkmate.

FORCED MOVE.

When a player has but one move at command.

MINOR PIECES

Are called the Bishops and Knights in contradistinction to the Queens and Rooks.

THE EXCHANGE.

A player giving a Rook in exchange for an adverse Knight or Bishop, is said to lose the exchange, because a Rook is of greater value.

FALSE MOVE.

When a player makes a move by which he violates the laws of the game, such as moving a Knight like a Bishop, or like a Rook, &c.

THE OPPOSITION.

When, at the end of a game, a player brings his King right opposite to the adverse King, whereby he arrests his progress, he has gained the opposition.

GAMBIT.

This word is derived from the Italian verb *gambetto*, to trip up. In Chess it means when a player, at the beginning of a game, gives up a Pawn in order to obtain a speedier development of his forces, and thus form an attack. There are a great many different gambits; the principal ones are: the King's gambit, the Queen's gambit, the Scotch gambit, the Evans' gambit (so named from Captain Evans, its inventor), the Lopez gambit, and the Damiano gambit. The King's gambit results from the following moves:—

WHITE.	BLACK.
1. K. P. 2.	1 K. P. 2.
2. K. B. P. 2.	2. P takes P.

The Queen's Gambit from:

WHITE.	BLACK.
1. Q. P. 2.	1. Q. P. 2.
2. Q. B. P. 2.	2. P. takes P.

J'ADOUBE

Is a French expression used in Chess, when a player replaces or touches a man without intending to move it; it signifies, "I adjust." (See Law IX.)

GIUOCO PIANO

Is the name of a certain opening. If after:

WHITE.	BLACK.
1. K. P. 2.	1. K. P. 2.
2. K. Kt. to B. 3.	2. Q. Kt. to B. 3.
3. K. B. to Q. B. 4.	3. K. B. to Q. B. 4.

White now plays:—

4. Q. B. P, 1.

This constitutes the Giuoco Piano.

DOUBLED PAWN.

When a player has two of his Pawns on the same file, the foremost one is called a *doubled Pawn*. A Trebled Pawn is of rare occurrence.

EN PRISE.

A piece or Pawn which can be taken by the enemy is said to be *en prise*, or in prize.

ISOLATED PAWN.

A Pawn which is separated from the rest—that is, there being no Pawns of his colour on either of the adjacent files—is termed an *isolated Pawn*.

PASSED PAWN.

When a Pawn in his march has no adverse Pawn to encounter, it is called a *passed Pawn*.

TAKING A PAWN IN PASSING, OR EN PASSANT.

It has been explained how a Pawn on his first starting may advance two squares at once; but if, in doing so, an adverse Pawn is so placed that it might have captured the advancing Pawn, had it only moved one square, a player has the option of either letting it pass, or taking it *in passing*, as if it had only advanced one step. No piece can take in passing, and a Pawn can only do so immediately in the next move.

THE CAPPED PAWN (PION COIFFE).

When there is a very great disparity between two players, the stronger one gives odds, in order to equalise the chances of winning. There is one kind of odds, which consists in the stronger player placing a ring, or some other distinguishing mark, on one of his Pawns, and undertaking to checkmate with that Pawn. He is not allowed to Queen it, and if he loses it he forfeits the game, as also if he gives checkmate with any other piece or Pawn. The Pawn usually marked is the Queen's or King's Knight's Pawn, because it can be best surrounded and sheltered.

Before attempting to play, the student should be acquainted with the laws of Chess, which are in general use at all the Chess Clubs in Great Britain. They have been revised by the London Chess Club, which was established in 1807, and comprises the best players in London. It is, therefore, justly looked upon as the highest authority in the United Kingdom.

THE LAWS OF CHESS.

1. The Chess-board must be so placed that either player has a white corner-square on his right hand. If such has not been observed, it may be corrected, provided that four moves have not been played on each side.

2. If a piece or pawn has been misplaced, the mistake may be rectified before four moves have been played on each side, but not afterwards.

3. A player having omitted to put up any of his men, may correct the error

before the completion of the fourth move, but not afterwards.

4. If a player, giving the odds of a piece or pawn, forgets to remove it from the board, his opponent has the option of proceeding with the game or recommencing it.

5. The first move is taken alternately, lots being drawn to determine the first move in the first game. On a game being drawn the party having had the first move in it moves first in the next game.

6. The player giving odds has the right of moving first in every game, unless otherwise agreed. When a pawn is given, it is always understood to be the King's Bishop's Pawn.

7. If a player touches a piece or pawn he must play it, unless, while touching it, he says, "J'adoube," or words to that effect.

8. As long as the player has not quitted the piece or pawn he has touched, he may play it to any square except where he took it from; but, having realised it, he may not recall the move.

9. Should a player touch one of his adversary's men, without saying, "J'adoube," or words to that effect, his adversary may compel him to take it, if it can legally be taken, or, if not, compel him to play his King; but if the King happens to be so situated that he cannot legally move, no penalty is inflicted.

10. If a player moves one of his adversary's men, the latter may inflict one or the other of the following three penalties: 1st, let him abide by it as if the move were correct; 2nd, make him take it, if it is *en prise;* 3rd, replace the piece or pawn and compel him to move his King.

11. If a player takes one of his opponent's men with one of his own that cannot take it without making a false move, his adversary can compel him to take it with any piece or pawn, if it is *en prise*, or compel him to move his own man which he has touched.

12. If a player takes one of his own men with another of his own, his opponent can compel him to move either.

13. If a player makes a false move, by playing a piece or pawn in an illegal manner, his opponent may compel him,—1st, to let the move stand good; 2nd, to move the touched piece or pawn correctly; 3rd, to replace the touched man and move his King.

14. If a player plays out of his turn, his adversary may let the moves remain, or compel him to retract the second.

15. When a pawn is moved two squares, and an adverse pawn could have taken it, had it been moved one square only, it may be taken *en passant* by the adverse pawn. A piece cannot take *en passant.*

16. A player cannot castle in the following cases:—1. If the King or Rook have been removed. 2. If the King is in check. 3. If there is any piece between King and Rook. 4. If the King has to pass over a square attacked by one of the adversary's pieces or pawns.—A player castling in violation of these laws, his opponent may either compel him to move the King or the Rook, or let the move remain.

17. If a player move a piece or pawn, thereby placing his King into check, he must replace the piece or pawn and move his King; but if the King cannot be legally moved, no penalty can be inflicted.

18. If a player attacks the adverse King without saying "check," his opponent is not obliged to attend to it; but if, on his next move, he says "check," each player must retract his last move, and the player whose King is in check must remove it.

19. If the King has been in check for several moves, and the moves subsequent to the check cannot be ascertained, the player whose King is in check must retract his last move and obviate the check.

20. If a player says "check," without giving it, and his opponent moves his King or any piece or pawn in consequence, he may retract such move; but if the former player has made a move since, the game must proceed.

21. A Pawn reaching the eighth square must be at once exchanged for any piece the player may think fit. He may make one or more Queens, three or more Rooks, Knights, &c.

22. If, at the end of a game, a player has power enough to checkmate his opponent, but does not know how to do it, his adversary may give notice that if checkmate be not effected in fifty moves, from the time he gives the notice, the game will be drawn.

23. A player, undertaking to checkmate with any particular piece or pawn, or on a particular square, is not restricted to any number of moves.

24. A stalemate is a drawn game.

25. If a player makes a false move, his opponent must notice it before touching any of his men, or he forfeits the right of inflicting any peualty.

26. If any dispute should arise on any case not provided for by the laws, or regarding the interpretation or applicability of any law, the players must refer the point to some disinterested bystander, or submit it to some good authority, whose decision must be considered conclusive.

ON THE OPENINGS.

The most important part of a game is its opening, or beginning, because the loss of the great majority of games can be traced to some wrong move or moves in the opening. It is, therefore, essential to be well acquainted with the different modes of attack and defence which are recognized the best in each opening. There are a great many of these, but we shall lay them before the student systematically and concisely.

We intend to divide them into six sections. The first is the K.B. opening, commencing thus:—

WHITE.	BLACK.
1. K. P. 2.	1. K. P. 2.
2. K. B. to Q. B. 4.	

2. The K. Kt. opening, beginning as follows:—

1. K. P. 2.	1. K. P. 2.
2. K. Kt. to B. 3.	

3. The K. B. gambit arising from:—

1. K. P. 2.	1. K. P. 2.
2. K. B. P. 2.	2. P. takes P.
3. K. B. to Q. B. 4.	

4. The K. Kt. gambit, arrived at by:—

1. K. P. 2.	1. K. P. 2.
2. K. B. P. 2.	2. P. takes P.
3. K. Kt. to B. 3.	

5. The Q. gambit, which the following moves constitute:—

1. Q. P. 2.	1. Q. P. 2.
2. Q. B. P. 2.	

6. The irregular openings, comprising all the modes of opening a game not treated of in the preceding sections, but

which, nevertheless, are of frequent occurrence, as, for example :—

1. K. P. 2. 1. Q. B. P. 2.

Or

1. K. P. 2. 1. Q. Kt. to B. 3, &c.

In order to imprint them the better on the memory, it has been found expedient to give White invariably the first move, which plan we shall also adopt. When playing, however, the student should take care to change men with his adversary at least at every sitting, so as not to contract the habit of playing always with the same colour.

We shall also, for the sake of brevity and distinctness, address White as the reader, speaking of Black in the third person.

SECTION I.

FIRST OPENING.

WHITE	BLACK.
1. K. P. 2.	1. K. P. 2.

In playing this, you open the passage for your Q. and K. B., and at the same time, you take possession of part of the centre, which is of great importance. You cannot make a better first move, though Q. P. 2 is perhaps as good. Black plays K. P. 2 in reply, to prevent your establishing your pawns in the centre, by playing Q. P. 2. or K. B. P. 2.

2. K. B. to Q. B. 4. 2. K. B. to Q. B. 4.

In playing out this B., you prepare for Castling, and you could not have placed him so advantageously on another square, because it now attacks the adverse K. B. P., which, before he has castled, is Black's most vulnerable point.

3. Q. B. P. 1. 3. K. Kt. to B. 3.

You play this P. with the view of pushing Q. P. 2, at the same time opening another passage for your Q. Black's reply is not good, because he exposes his Kt. to an attack from your P. He would have done better to play Q. to K. 2, or Q. P. 2, both of which moves we shall analyse hereafter.

4. Q. P. 2. 4. P. takes P.

You play this in order to occupy the centre, and also to intercept the adverse B. He is right in taking P with P. Had he retreated his B., you would have laken P. with P., and if, then, he took your K. P. with Kt., you would play Q, to Q. 5.

5. P. takes P. 5. K. B. to Q. Kt. 3.

You have now two pawns in the centre, which is very advantageous. Black loses time in thus retreating his B.; he ought to have played it to Q. Kt. 5, giving check.

6. Q. Kt. to B. 3. 6. Castles.

You play this to defend your K. P., and to prevent his playing Q. P. 2, which would have destroyed your centre. Black might also have played Q. P. 8; but had he taken your K. P., in order to play Q. P. 3, if you retook with Kt., you would first have taken his K. B. P. with your B., saying check, which would have deprived him of castling.

7. K. Kt. to K. 2. 7. Q. B. P. 1.

You play this Kt. out in order to castle, and you play him to that square rather than to B. 3, where it would have impeded the advance of your K. B. P. Black prepares to break your centre by playing Q. P. 2. Had he, instead, taken your K. P. with Kt., you would have obtained a winning position as follows:—Suppose

	7. Kt. takes K. P.
8. Kt. takes Kt.	8. Q. P. 2.
9. Q. Kt. to K. Kt. 5.	9. P. takes B.

10. Q. to Q. B. 2. 10. K. B P. 2 (or K. Kt. P. 1.*)
11. Q. takes Q. B. P. (ch.) 11. K. to R. sq.
12. Kt. to K. B. 7.

Black is now compelled to take this Kt. to avoid the smothered mate.

*10. K. Kt. P. 1.
11. Q. takes Q. B. P.,

And White has the better game.

8. K. B. to Q. 3.

In order to avoid exchanging your K. P. against his Q. P. when he plays it 2 squares, and you retire it there in preference to Q. Kt. 3, because in the latter place it would be masked by the adverse Q. P., whereas at Q. 3 it will bear on the adverse K. R. P. You have a good game, owing to Black's third and fifth moves. The subjoined variation shows how the game would have proceeded had he played K. B. to Q. Kt. 5 (ch.), on his fifth move:—

VARIATION AT BLACK'S FIFTH MOVE.

5. K. B. to Q. Kt. 5 (ch.)

This is the correct move; because it enables him to play Q. P. 2, and thus break your centre.

6. Q. B. to Q. 2. 6. B. takes B. (ch.)

You played the right move; any other would have lost your K. P. He takes your B. to save time.

7. Q. Kt. takes B. 7. Q. P. 2.

By retaking thus, you protect your K. P. Black's move is very well played; because, whether you take or not, he breaks up your centre, at the same time giving egress to his Q. B.

8. P. takes P. 8. Kt. takes P.

You take thus because your B. is well placed there. Black might also have castled first, as to defend that P. would have lost you time.

9. Q. to Q. Kt. 3. 9. Q. B. P. 1.

You attack his Kt. a second time, and, if he retires it, you take his K. P. B., checking; he cannot defend it with his Q. B., without losing his Q. Kt. P. Black's move is the best he could make; had he played Q. to K. 2 (ch.), you would have played K. to B. sq.

10. K. Kt. to K. 2. 10. Castles.

You play the Kt. there to prevent Black's giving check with Q., which would now improve his game. He Castles in order to play his K. Kt. to to Q. Kt. 3, and then bring out his Q. B.

In this position the game is about equal, although White's forces are better developed.

SECOND GAME.

ON THE OPENINGS.

FIRST OPENING.

WHITE.	BLACK.
1. K. P. 2.	1. K. P. 2.
2. K. B. to Q. B. 4.	2. K. B. to Q. B. 4.
3. Q. B. P. 1.	3. K. Kt. to B. 3.
4. Q. P. 2.	4. P. takes P.
5. K. P. 1.	5. K. Kt. to K. 5.

Your last move is an attacking one; you threaten to win his Kt. He has three modes of saving it (without counting his playing it home again, in which case you would take P. with P. and gain time). We shall first examine the move in the text of Kt. to K. 5, and then, in the variations, show the effect of his playing 5. Q to K. 2, and 5. Q. P. 2.

6. Q. to K. 2. 6. K. Kt. to Kt. 4.

Had he attempted to defend his Kt. by playing Q. P. 2, or K. B. P. 2, you might have taken *en passant* with your R. P., still leaving his Kt. exposed.

7. K. B. P. 2. 7. K. Kt. to K. 3.

By thus pursuing the Kt, you gain much time, and prevent the development of his forces. His move is forced.

8. K. B. P. 1. 8. K. Kt. to K. B. sq.

This is his best move; for had he played him back to Kt. 4, you should have played Q. to K. R. 5; and if then he supports him by K. R. P. 1, you would win him by playing K. R. P. 2.

9. K. Kt. to B. 3. 9. Q. Kt. to B. 3.

This is your best move for maintaining the attack, as it enables you to play out your Q. B. to attack his Q. Black plays out his Q. Kt. to prevent your taking P. with P. If he had taken your B. P. with P., you should have replied with Q. B. to K. Kt. 5; and if then he played K. B. to K. 2, having no other move, you would win by playing K. B. P. 1.

10. Q. B. to K. Kt. 5. 10. K. B. to K. 2.

Had he, instead, played Q. Kt. to K. 2, you would also have replied with K. B. P. 1.

11. K. B. P. 1. 11. P. takes P.

If he does not take with P., but plays B. away, you would take his Kt. P. with P., attacking Q. R. and Kt. at the same time.

12. P. takes P.

You now gain a piece, and having a good position, you should win the game if you play with care.

VARIATION ON BLACK'S MOVE.

5. Q. to K. 2.

This is not a good move in this position; but as it presents some striking combinations, we shall examine it.

6. P. takes P. 6. K. B. to Q. Kt. 5 (ch.)

If, instead of checking, he had retreated his B. to Q. Kt. 3, you should have played Q. to K. 2.

7. K. to K. B. sq. 7. K. Kt. to K. 5.

This is your best move, as it enables you to take his Kt. with P. If, in lieu of playing your K., you had interposed either B. or Kt., Black would have extricated himself by playing away his Kt. to K. 5, and by exchanging it afterwards against one of your pieces.

8. Q. to K. Kt. 4. 8. K. B. P. 2.

By this move you attack his Kt., and at the same time his K. Kt. P.; if he retreats it to be K. B. 3, you would, of course, not take him with your P., because his Q. would checkmate you on the move, but take his K. Kt. P. with Q. winning a piece. If he retreats his K. Kt. to Q. 3, you should reply K. B. to K 2, and his Kt. will be lost.

9. Q. to K. K. 5. (ch.) 9. K. Kt. P. 1.

You would have weakened your attack by taking his B. P. with your Q , as he might have replied with Kt. to Q. 3. exchanging your K. B. against his Kt. If Black plays his K. to Q. sq. instead of K. Kt. P. 1, you should play K. B. P. 1, driving his Kt. away, and then play either Q. B. to K. Kt. 5, or Q. to K. R. 4, according to where he retreats his Kt.

10. Q. to K. R. 6. 10. K. Kt. to Q. 3.

You play your Q. there to prevent the

adverse Kt. being played to K. Kt. 4. Black plays his Kt. there in order to play him to K. B. 2 next move, attacking your Q. Had he offered an exchange of Queens, by playing Q. to K. B. square, you should have played K. B. P. 1, winning his Kt.

11. Q. B. to K. Kt. 5. — 11. K. Kt. to K. B. 2.

If he plays his Q. to K. B. sq., you take his Kt. at once.

12. B. takes Q. — 12. Kt. takes Q.

13. Q. B. takes B.

You win a piece and have a good position.

SECOND VARIATION AT BLACK'S FIFTH MOVE.

5. Q. P. 2.

This is his best move.

6. K. P. takes Kt. — 6. Q. P. takes B.

You might also have retreated your B. to Q. Kt. 3, a move recommended by Allgaier, Lewis, and Walker. We subjoin a variation on that move.

7. P. takes K. Kt. P. — 7. K. R. to Kt. sq.

If you had played Q. to K. R. 5, instead, he might have castled with a good position.

8. Q. to K. R. 5. — 8. Q. to Q. 3.

You threaten by your last move to take his K. R. P., besides attacking his K. B. Black might protect all by checking first with Q. at K. 2, and then taking P. with R., but you would, when checked, play Q. to K. sq., and then, playing out your K. Kt., threaten to play R. to K. sq.

9. Q. takes K. R. P.

The game is now about even.

6. K. B. to Q. Kt. 3. — 6. K. Kt. to K. 5.
7. P. takes P. — 7. Q. to K. R. 5.
8. K. Kt. P. 1. — 8. Kt. takes K. Kt. P.
9. K. B. P. takes Kt. — 9. Q. to K. 5. (ch.)
10. K. to K. B. sq. — 10. Q. takes R.
11. P. takes B. — 11. Q. B. to K. R. 6. (ch.)
12. K. to B. 2. — 12. Q. takes R. P. (ch).
13. K. to K. 3. — 13. Q. takes K. Kt. P. (ch.)
14. K. Kt. to B. 3.

Black has the advantage.

Your 8th move might be modified: suppose—

8. Q. to K. B. 3. — 8. K. B. takes P.
9. K. B. takes P. — 9. Q. takes K. B. P. (ch.)
10. K. to Q. sq. — 10. K. B. takes Q. Kt. P.
11. Q. B. takes B. — 11. Q. takes B. and wins.

Or

8. Q. B. to K. 3. — 8. K. B. to Q. Kt. 5. (ch.)
9. K. to K. B. sq. — 9. Q. B. P. 1.
10. K. Kt. to B. 3. — 10. Q. to K. 2.

Black has now the better game, because he can castle, and then advance his K. B. P. one or two squares, according to your play, and he will have his Rooks in play before you. We will yet remark that if you had on your tenth move played K. Kt. P. 1, instead of K. Kt. to B. 3, as given above, Black would have played Q. B. to K. R. 6 (ch.), and you would have had great difficulty in bringing your K. R. into action.

1. K. P. 2. — 1. K. P. 2.

SECOND OPENING.

WHITE.	BLACK.
3. K. B. to Q. B. 4.	2. Q. B. to Q. B. 4.
3. Q. B. P. 1.	3. Q. Kt. to B. 3.

He plays this Kt. out to prevent your playing Q. P. 2.

4. Q. P. 2. 4. P. takes P.

You give up that P. to win another, and get a good position. If Black, instead of taking P. with P., retreats his B. to Q. Kt. 3; if, then, he takes P. with P., you retake with Q. B. P.; suppose he then plays Q. B. 1., you Castle; if, then, he plays Q. B. to K. 3, you play Q. P. 1; he will then play Kt. to K. 4, or Q. R. 4, attacking your B., but you take his Q. B. with your P.; and if then he takes B. with Kt., you take his B. P. with your P., checking; and if his K. takes the P., you play Q. to Q. 5, checking, and win his Kt.

5. K. B. takes K. B. P. (ch.) 5. K. takes B.

It often happens, at the beginning of a game, that the K. B. P. can be taken with the K. B. advantageously. Black takes the B. with K., in preference to playing his K., for you would then take his Kt., and make him lose time.

6. Q. to K. R. 5 (ch.) 6. K. Kt. P. 1.
7. Q. takes K. B. 7. Q. P. 1,
8. Q. to Q. Kt. 5.

You retire the Q. to that square to prevent his playing out his Q. B., which he would have done, if you had played your Q. to Q. B. 4.

Your position is now better than his. He has but the privilege of Castling; and his K. is exposed to an attack from your Ps. on the K. side, which you may advance with safety.

THIRD OPENING.

3. Q. P. 1.

He plays this to protect his K. B. and let his Q. B. out, but, at the same time, gives you time to establish your P's. in the centre.

4. Q. P. 2. 4. P. takes P.
5. P. takes P. 5. K. B. to Q. Kt. 5 (ch.)
6. Q. B. to Q. 2. 6. B. takes B. (ch.)
7. Kt. takes B. 7. K. Kt. to B. 3.

If, on the 7th move, Black had played Q. B. to K. 3, you should have taken him with your B., and on his retaking with his B. P. you would play Q. to K. B. 5 (ch), compelling him either to play his K. (and then his R. would be a long time coming into action), or to play K. Kt. P. 1, in which case you would play Q. to Q. Kt. 5 (ch.), winning his Q. Kt. P.

8. K. B. to Q. 3. 8. Castles.
9. K. Kt. to K. 2.

Your position is good, like in the first opening. Your Ps. thus placed in the centre, render the development of your opponent's pieces difficult.

FOURTH OPENING.

3. Q. to K. B. 3.

Black plays this to prevent the advance of your Q. P.; at the same time he threatens you with mate.

4. K. Kt. to B. 3. 4. Q. Kt. to B. 3.

Your move is well played; you cover the menaced K. B. P., and bring a piece into play. You might have played Q. to K. 2 instead; but the Q. is better at her square, in order to enable you to play Q. P. 2. Black lays his Q. Kt. out to prevent your playing Q. P. 2.

5. Q. Kt. P. 2. 5. K. B. to Q. Kt. 3.

it is not generally advisable to advance the flank Ps.; for it is difficult to defend them, and the game gets too open. Here you play it in order to bring out your Q. Kt. to R. 3, without its being taken off by his K. B. Black's move is correctly played.

6. Q. R. P. 2. 6. Q. R. P. 1.

In playing this, you compel Black to play his Q. R. P. If he had played Q. R. P. 2, you would have played Q. Kt. P. 1.

7. Q. P. 1. 7. Q. P. 1.

You play thus to bring out your Q. B.

8. K. R. P. 1. 8. K. R. P. 1.

You play this P. to prevent his Q. B. being played to K. Kt. sq., which would hamper your Q.; you also open a retreat for your Kt. You might also have played Q. B. to K. 3; and if his K. B. took it, you would retake with P.. and, the move after, Castle, with a fine game; or, if he retired his K. B., you would play Q. Kt. to Q. 2. Black plays his K. R. P. to prevent your attacking his Q. with Q. B.

9. Q. to K. 2. 9. Q. B. to K. 3.

You play your Q. in order to put, presently, your two Rs. into communication, and you place her there to protect your K. B. P., in case you should wish to play your K. Kt. away. Black opposes his Q. B. to your K. B. in order to exchange one of his pieces, which is not in play, against one of yours which is well posted. In this position you play your Q. Kt. to R. 3, and your position will be preferable to Black's.

FIFTH OPENING.

3. Q. to K. Kt. 4.

This is a bad move for the defence.

4. Q. to K. B. 3. 4. Q. to K. Kt. 3.

You play the Q. thus to protect your K. Kt. P., at the same time attacking his K. B. P. you compel him to make a defensive move. If, instead of retiring his Q where he does, he had played out his K. Kt. to B. 3, you would also have played—

5. K. Kt. to K. 2. 5. Q. P. 1.

Your last move enables you to play Q. P. 2, and also to Castle. Black plays Q. P. 1, in order to give egress to his Q. B.

6. Q. P. 2. 6. Q. B. to K. Kt. 5.

Black's last move is bad. He attacks your Q. with the intention of taking your K. Kt. if you remove her, and thus win a P.; but you frustrate his design as follows:—

7. K. B. takes K. B. P. (ch.) 7. Q. takes B.

8. Q. takes B.

And you have a fine game; for if he takes P. with P., you reply with Q. to Q. B. 8 (ch.), and then take his Q. Kt. P.

SIXTH OPENING.

3. Q. to K. R. 5.

Black brings his Q. out too early; and you will gain time by attacking and driving her back.

4. Q. to K. 2. 4. K. Kt. to B. 3.

You play this to protect both your K. P. and K. B. P.

5. Q. P. 1. 5. K. Kt. to Kt. 5.

6. K. Kt. P. 1. 6. Q. to K. B. 3.

In lieu of K. Kt. P. 1, you might also have played K. Kt. to B. 3. Black then could have taken your K. B. P. with B. or Q., giving check. In the former case you play K. to Q. sq., and then, on his retreating his Q. to R. 4 (his best move), you play R. to B. sq., with an attacking position. In the latter case, you would exchange Qs.; and if he retakes your Q. with B., you would play your K. to K. 2, he would be obliged to retire his B. at once, to B. 4, or Kt. 3, whereupon you play K. R. P. 1, and then win his K. P.

7. K. Kt. to R. 3. 7. Q. P. 1.

It is not good to place your Kt. on the R. file; for, besides having only half their power in such a position, they are liable to be taken by the adverse B.

8. K. R. P. 1. 8. K. Kt. to K. 6.

Your move is well played. You should always endeavour to drive back or exchange pieces of your adversary's which get into your half of the board. Black plays this to avoid going backwards, which would have embarrassed his position.

9. Q. B. takes Kt. 9. B. takes B.
10. Q. takes B. 10. B. takes Kt.
11. Q. Kt. to Q. 2.

And you have a slight advantage.

SEVENTH OPENING.

3. Q.B.P.1 (a bad move).
4. Q. P. 2. 4. Q. P. 2.

If Black had taken P. with P. instead, you would have replied with K. B. takes B. P. (ch.); and then Q. to K. R. 5, if K. took B.

5. K. B. takes P. 5. P. takes B.
6. P. takes B. 6. P. takes P.
7. Q. to Q. R. 4 (ch.)

And you win a B. in an equal position.

EIGHTH OPENING.

3. K. B. P. 1.

This is a worse defence than the preceding one.

4. B. takes Kt. 4. R. takes B.
5. Q. to K. R. 5 (ch.)

And next move you take his K. R. P., compelling Black to play his K. to defend his R.

NINTH OPENING.

WHITE.	BLACK.
	3. Q. R. P. 1.

By this move Black affords you time to establish your pawns in the centre.

4. Q. P. 2. 4. P. takes P.
5. P. takes P. 5. K. B. to Q. R. 2.

Instead of taking P. with P. you might also have taken K. B. P. checking, as in the second opening; but this is quite as good.

6. Q. B. to K. 3. 6. Q. B. P. 1.

Allgaier says, the game is now even; but *Calvi* thinks that White has the advantage, because of his centre pawns.

7. K. B. to Q. 3. 7. K. Kt. to B. 3.

If, instead of thus retreating your B., you had played Q. Kt. to B. 3, Black would have replied with Q. Kt. P. 2; and then, on your retreating your B., Q. Kt. P. 1, when you would have been obliged to play your Kt. home again, in order not to embarrass your game.

8. Q. Kt. to B. 3. 8. Q. P. 1.
9. K. R. P. 1. 9. Castles.

You play K. R. P. 1 to prevent Black from playing his Q. B. to K. Kt. 5. Black, having Castled, you should play K. B. P. 2; then, by playing your Q. to K. B. 3, and advancing your K. Kt. P. and K. R. P., you will obtain a strong attack.

TENTH OPENING.

1. K. P. 2.	1. K. P. 2.
2. K. B. to Q. B. 4.	2. K. B. to Q. B. 4.
3. Q. B. P. 1.	3. Q. P. 2.

Black's last move is the invention of Lewis.

4. B. takes P.	4. K. Kt. to B. 3.

If you had taken P. with P. instead, Black would have taken your B. P., checking, and, on your taking B. with K., have checked with Q. at K. R. 5, winning your B. in return. Black plays out his Kt. in order to regain the P. by taking your B. You have now various moves at command to protect the P. If you play Q. to K. B. 3, he will take your B., and then Castle. If you play Q. to R. 4. (ch.) he will play Q. B. P. 1; and if now you take Q. P., checking, he will play his K., and have e better game. If you play Q. to Q. Kt. 3, he Castles; and if, then, you take his Q. Kt. P. with B., he will first take B. with B., and then, playing Q. to Q. 6, his attack will be irresistible. If you play Q. P. 2, he takes P. with P.; and, on your retaking, he plays B. to Q. Kt. 5, (ch.), then he takes B. with Kt., and has the attack.

5. Q. to Q. Kt. 3.	5. Castles.

Black Castles, to defend his K. B. P. and get his R. into action. See "A New Treatise of Chess." By George Walker, 3rd. edition, p. 88.

6. K. Kt. to B. 3.	6. Q. B. P. 1.

Black might have played Kt. to Kt. 5; in which case you would have replied with Q. P. 2, and had the better game. Or he might have played Q. Kt. to Q. 2, to defend his K. P., then your reply should be, Q. P. 1.

7. K.B. takes B.P. (ch.)	7. R. takes B.

If, instead of taking the B., Black plays his K., you should play in the following manner:—

Q. P. 2.	P. takes P.
K. P. 1.	Q. to K. 2.
Castles.	R. takes B.
P. takes Kt.	Q. takes P.
P. takes P.	

And you would have the better game.

8. Kt. takes K. P.	8. Q. to K. 2.

If Black, in lieu of Q. to K. 2, takes your K. B. P. (ch.), you should play K. to B. square; for if you were to take B. with K., he would play Kt. to Kt. 5, double-check; and then he would take off your Kt., which is the strength of your game.

9. Q. takes R. (ch.)	9. Q. takes Q.
10. Kt. takes Q.	10. K. takes Kt.

You then play Q. P. 2, and K. B. P. 1; after that, K. to B. 2, so as to support the pawns when they advance, and have a fine game. As to numerical force, you are a P. a-head; for two minor pieces are worth a R. and two pawns only.

VARIATION AT BLACK'S FIFTH MOVE.

	5. Kt. takes B.
6. Q. takes Kt.	6. Q. to K. Kt. 4.

If instead of retaking with Q., you take with P., Black will have the better game. Black might also have exchanged Queens, in which case, the game might have proceeded as follows:—

K. P. takes Q.	Q. Kt. to Q. 2.
Q. B. P. 1.	Kt. to Q. Kt. 3.
Q. Kt. P. 1.	

Not Q. P. 1, which would compromise your game.

7. K. Kt. P. 1.	7. Q. Kt. to Q. 2.

Black might also have retired his K. B. to Q. Kt. 3.; but you would still have played:—

8. K. B. P. 2.	8. Q. to K. B. 3.
9. K. Kt. to K. 2.	9. Q. B. P. 1.
10. Q. to Q. 3.	

You retire the Q. there to play her afterwards to K. B. 3, when you will have a good position.

ELEVENTH OPENING.

3. Q. to K. 2.

This is a good move; it prevents you from playing Q. P. 2.

4. K. Kt. to B. 3.	4. Q. P. 1.

Your last is a good move. If you had played K. B. P. 2 instead, Black would not take P. with P.—which would subject him to a difficult attack, as will be shown below—but, by taking your K. Kt. with B., and, on your retaking with R., playing his Q. to Q. B. 4, he would win a piece. Now, let us suppose you had played—

4. K. B. P. 2,

And he replies with—

	4. P. takes P. (ch.)
5. Q. P. 2.	5. Q. takes P.
6. K. to B. 2.	6. K. B. to K. 2.
7. K. Kt. to B. 3.	7. K. Kt. to B. 3.
8. K. R. to K. sq.	8. K. Kt. to Kt. 5 (ch.)
9. K. to Kt. sq.	9. Kt. to K. 6.
10. B. takes Kt.	10. P. takes B.
11. Q. Kt. to Q. 2.	11. Q. to K. B. 5.
12. Q. Kt. to K. B. sq.	12. Castles.
13. Kt. takes P.	

And, although you have a P. less, you have a better game than Black.

Now let us return to black's fourth move of Q. P. 1. If he had taken your K. B. P. with B., checking, you would have taken his B. with your K.; he would then have checked with his Q. at Q. B. 4; you then play Q. P. 2, he takes your B. with Q., and you take his K. P. with Kt.; and you would have the better game. (See "Trattato del gioco di Scacchi di Salvio," Napoli, 1604, page 44.)

5. Q. P. 1.	5. K. Kt. to B. 3.
6. Castles	6. Q. B. to K. 3.

The game may now be considered equal. Had you, in lieu of Castling, played K. Kt. to Kt. 5, Black would have replied by Castling, having the better game.

VARIATION, BEGINNING WITH WHITE'S FOURTH MOVE.

4. K. Kt. to B. 3.	4. K. Kt. to B. 3.

This variation is given by Philidor.

If you had played your Kt. to K. 2 instead, Black might have won a P., by taking your K. B. P., checking; and then, if you took his B. with K., he would have checked with his Q. at B. 4, and taken your K. B.

5. Q. to K. 2.	5. Q. P. 1.

If he plays Kt. to Kt. 5 instead, you play Q. P. 2, and thus establish your pawns in the centre.

6. Q. P. 1.	6. Q. B. P. 1.

You might have played Q. P. 2, but you could not have maintained your pawns in the centre. Black might have played 6 Q. B. to K. Kt. 5, in which case you should have played K. R. P. 1 at once. As a general rule, it is not good to leave your pieces pinned.

7. K. R. P. 1.	7. K. R. P. 1.

You both play thus to prevent your Kts. being pinned.

8. Q. B. to K. 3.	8. B. takes B.
9. Q. takes B.	9. Q. B. to K. 3.
10. B. takes B.	10. Q. takes B.

You now see the utility of having at the 7th move played K. R. P. 1, without which he could now have played K. Kt. to Kt. 5, and then K. B. P. 2.

11. Q. Kt. to B. 3.	11. Q. Kt. to Q. 2.
12. Castles.	12. Castles.

The game is even. White has maintained the advantage of the first move. Whichever of the two players will first be able to play his K. B. P. 2 will have the advantage in position.

These eleven openings, which we have just analysed, show the best variations for the first player. The best defence is that indicated in the eleventh opening. The first and tenth also show the means of attack.

TWELFTH OPENING.—LOPEZ GAMBIT.

WHITE.	BLACK.
1. K. P. 2.	1. K. P. 2.
2. K. B. to Q. B. 4.	2. K. B. to Q. B. 4.
3. Q. to K. 2.	3. Q. B. P. 1.

By playing your Q. to K. 2, you threaten to take the K. B. P. with your B., checking; and if K. takes B., to play Q. to Q. B. 4, giving check. and then take the adverse B. in return. Black's third move is bad, because it does not prevent the indicated attack, and gives his adversary time to form an attack, as we will show. He might instead have played 3. Q. P. 1; or, 3. K. Kt. to B. 3; or, 3. K. Kt. to K. 2; or, 3. Q. Kt. to B. 3, all which modes of defence we will proceed to analyse, reserving to the last that which we consider the best.

4. K. B. P. 2.	4. B. takes Kt.

Your last is a very attacking move; but Black's reply is bad. He takes off your Kt. with the view to prevent your Castling on K.'s side; but you are amply compensated for this disadvantage by the superior position you obtain. He should rather have played Q. P. 1. We subjoin a variation, showing the effect of Black's playing 4 P. takes P.

5. R. takes B.	5. P. takes P.

Black's last move is very bad; it allows you to establish your Ps. in the centre, and to develop your game.

6. Q. P. 2.	6. Q. to K. R. 5 (ch.)

Black thus protects his P., but embarrasses his Q., and gives his adversary time to bring his pieces into action.

7. K. Kt. P. 1.	7. P. takes P.
8. R. takes P.	8. Kt. to B. 3.

Black now attacks your K. P. If, in lieu of this, he had played K. R. P. 1, you should have replied by Q. to K. B. 2.

9. Q.B. to K. Kt. 5.	9. Q. to K. R. 4.
10. Q. to K. Kt. 2.	10. K. Kt. to Kt. 5.

If you take Kt. with R., Black replies with Q. P. 2, recovering a piece. But if he had played Q. P. 2 at once, you should have retreated your K. B. to K. 2, and then Q. B. to Q. 2, winning a piece.

We shall not proceed with this game, White having so much the advantage.

VARIATION AT BLACK'S FOURTH MOVE.

	4. P. takes P.
5. K. Kt. to B. 3.	5. K. Kt. P. 2.

Black plays this to support his double P.

6. Q. P. 2.	6. K. B. to Q. Kt. 3.
7. K. R. P. 2.	7. K. Kt. P. 1.

By your last move you break up Black's position. If he had defended his P. by K. R. P. 1, you would have taken P. with P., and he could not have retaken; or if 7. K. B. P. 1, you take P. with Kt., and then check with Q.

8. K. Kt. to K. 5.	8. K. Kt. to R. 3.
9. Q. B. takes P.	9. K. B. takes P.
10. Q. B. P. 1.	10. B. takes Kt.
11. Q. B. takes B.	11. K. R. to Kt. sq.

You now play Q. B. to Q. 6, confining his pieces, and preventing his Castling, and you have the better game.

THIRTEENTH OPENING.

	3. Q. P. 1.
4. Q. B. P. 1.	4. Q. Kt. to B. 3.
5. K. B. P. 2.	5. P. takes P.

Black should rather have played K. Kt. to B. 3.

6. Q. P. 2.	6. Q. to K. R. 5 (ch.)
7. K. to Q. sq.	7. K. B. to Q. Kt. 3.
8. K. Kt. to B. 3.	8. Q. to K. Kt. 5.

In attempting to defend his doubled P., Black gives you time to bring out your pieces, attacking his Q,

9. K. R. P. 1.	9. Q. to K. Kt. 6.
10. Q. Kt. to Q. 2.	10. K. Kt. to B. 3.
11. K. R. to K. sq.	11. K. Kt. to R. 4.
12. K. P. 1.	

In this position you have the advantage. You will attack the Q. by Q. Kt. to K. K. 4; then by K. Kt. to R. 4. You then play K. Kt. P. 2, in order to drive back his K. Kt., and then you will be able to capture the doubled P. with your Q. B.

FOURTEENTH OPENING.

WHITE.	BLACK.
	3. K. Kt. to B. 3.
4. Q. B. P. 1.	4. Castles.

If, instead of Q. B. P. 1, you had taken the adverse K. B. P. with your B., you would have had a bad game, as we have shown in a preceding lesson. Black, by Castling, brings his K. R. into play.

5. Q. P. 1.	5. Q. B. P. 1.

Black plays this with the intention of throwing up his Q. P., two squares next move.

6. Q. B. to K. Kt. 5.	6. Q. P. 2.
7. K. B. to Q. Kt. 3.	7. P. takes P.

Your last move is the correct one. Had you taken P. with P., he would have retaken with P., and thus established two P.'s in the centre. If you had taken off his Kt. with your B., he would have retaken with P., and had a fine game. 8. P. takes P., and the game is about even.

FIFTEENTH OPENING.

	3. K. Kt. to K. 2.

This is not a good move. It prevents your playing K. B. P. 2, but if you take his K. B. P. checking, and then check with Q. at Q. B. 4, and then take his K. B., you will win a P. and be able to Castle soon.

4. K. B. P. 2.	4. Q. P. 1.

You should rather have played K. Kt. to B. 3.

5. K. Kt. to B. 3.	5. Q. Kt. to B. 3.
6. Q. B. P. 1.	6. Castles.

In this position the game is equal.

SIXTEENTH OPENING.

	3. Q. to K. 2.

This is a good defence. As a general rule it is always good to oppose your Q. to your adversary's.

4. K. B. P. 2.	4. K. Kt. to B. 3.
5. K. Kt. to B. 3.	5. Q. P. 1.

Black advances this P. to protect his K. P., and to open his Q. B., which is very important at the beginning of a game.

6. Q. Kt. to B. 3.	6. Q. B. P. 1.

Black plays this to prevent the adverse Kt. attacking his Q. It is true that his K. Kt. might take him, but he may want to play it away presently.

7. Q. P. 1.	7. Q. B. to K. Kt. 5.
8. K. B. P. 1.	8. Q. Kt. to Q. 2.
9. Q. B. to K. Kt. 5.	9. K. R. P. 1.
10. Q. B. to R. 4.	10. K. Kt. P. 2.

You may now take P. in passing, or retire your Q. B. to K. B. 2, but the game, in either case, is equal.

SEVENTEENTH OPENING.

	3. Q. Kt. to B. 3.
4. Q. B. P. 1.	4. K. Kt. to B. 3.

You might, in lieu of your fourth move, have K. B. P. with your B., checking. (See first variation.)

5. K. B. P. 2.	5. B. takes Kt.
6. R. takes B.	6. Castles.
7. Q. P. 1.	7. Q. P. 2.

You might have taken P. with P. (See second variation.)

8. B. takes P.	8. Kt. takes B.

If you had taken with P. instead, Black would have taken your P. with Kt., and if, then, you had taken P. with P., he might have retaken with Q. Kt., and he would have had the better position.

9. P. takes Kt.	9. K. P. takes P.
10. B. takes P.	10. R. to K. square.

If, in place of taking P. with B., you had played Q. to K. B. 3, Black would have replied with Q. Kt. to K. 4. Black would have weakened his attack by taking P. with Q.

11. Q. B. to K. 3.	11. Kt. to K. 4.
12. K. R. P. 1.	12. Q. B. to K. B. 4.
13. Q. P. 1.	13. Q. B. to Q. 6.

Next move he plays his Kt. to Q. B. 5, and wins a piece, at the least.

FIRST VARIATION.

4. K. B. takes B. P. (ch.)	4. K. takes B.
5. Q. to Q. B. 4 (ch.)	5. Q. P. 2.
6. Q. takes B.	6. P. takes P.

If, instead of your last move, you had taken P. with P., Black would have taken your B. P. with his B., saying check, and then played Q. Kt. to R. 4.

7. Q. to Q. B. 4 (ch.)	7. Q. B. to K. 3.

In attempting to win a P. with your Q., you give your adversary time to develope his forces, and you have now a lost game.

8. K. takes doubled P.	8. K. Kt. to B. 3.

In this position you have the choice between six squares for your Q., but to whichever you play her, you have a bad game. Five of these are not even worth analysing. The best is—

9. Q. to K. R. 4.	9. Q. Kt. to Q. 5.

If you had played Q. to Q. R. 4, Black would have replied by playing Q. to Q. 4.

Black by his last move threatens to take your Q. B. P., checking, and then your R.

10. Q. Kt. to K. 3.	10. K. P. 1.
11. Q. B. P. 1.	11. K. Kt. P. 2.

If you had played—

11. Q. P. 1.	11. P. takes P.
12. P. takes P.	12. Q. Kt. to K. B. 4.
13. Q. to K. R. 3.	13. K. R. to K. sq.

and Black has a fine game. Or, if—

11. K. Kt. to B. 3.	11. K. R. P. 1.

with the intention to win your Q. if you castle. And if—

11. K. Kt. to K. 2. 11. Kt. takes K.
12. K. takes Kt. 12. Q. to Q. 5.

and Black would have had the advantage.

12. Q. takes P. 12. K. R. to Kt. sq.
13. Q. to K. 3. 13. Q.Kt. to K.B.4.
14. Q. to K. 2. 14. R. takes Kt. P.
15. Q. Kt. to B. 2. 15. Q. to Q. 3.
16. Q. Kt. to K. 3. 16. Kt. takes Kt.
17. Q. P. takes Kt. 17. Q.R.toK.Kt.sq.
18. Q. to K B. sq. 18. R. R. to Q. sq.
19. Q. to K. 2. 19. Kt. to Kt. 5.
20. Kt. to R. 3. 20. Kt. to K. 4.
21. Kt. to B. 4. 21. Kt. to B. 6 (ch.)
22. K. to B. sq.

Black mates in six moves.

SECOND VARIATION.

7. P. takes P. 7. Q. Kt. takes P.
8. K.B. toQ.Kt.3. 8. K. Kt. takes P.
9. Q. takes Kt. 9. R. to K. sq.
10. K. to Q. sq. 10. Q. P. 2.

Black judiciously sacrifices this P. in order to bring his Q. B., and afterwards his Q. R. into play.

11. Q. takes P. 11. B.toK.Kt.5(ch.)

If you had taken P. with B., instead, Black would have played Q. B. P. 1.

12. K. to B. 2. 12. Q. to K. B. 3.

And Black, although a piece minus, has a forced won game.

EIGHTEENTH OPENING.

1. K. P. 1. 1. K. P. 2.
2. K. B. to Q. B. 4. 2. K. B. to Q. B. 4.
3. Q. to K. B. 3. 3. K. Kt. to B. 3.

In playing out your Q. thus early in the game, you expose her to the attack from your adversary's minor pieces, and also deprive your K. Kt. of its best square. It is only by beginners, or inferior players, that such a move is made, in the hope of giving checkmate, by taking K. B. P. with Q. Black's move is well played.

4. Q. to K. Kt. 3. 4. Q. to K. 2.

By your last move you attack the adverse K. P., and K. Kt. P. You might also have played K. P. 1. (See variation.) Black might also have castled instead of his last move. If then you had taken his K. P. with Q., he would have taken your K. B. P., checking, and if you capture B. with K., he would play Kt. to Kt. 5, checking both K. and Q.

5. Q. takes K. Kt. P. 5. R. to Kt. sq.

By thus imprudently capturing this P. you lose the game in a few moves.

6. Q. to K. R. 6. 6. K.B. takesB.P.(ch.)
7. K. to B. sq. 7. Q. P. 2.

Black sacrifices this P. in order to bring his Q. B. into operation, at the same time he attacks your K. B.

8. K. B. to K. 2. 8. R. to Kt. 3.

Your Q. being now lost, Black will win the game easily.

VARIATION.

4. Q. P. 4. Q. P. 1.
5. Q. B. toK. Kt. 5. 5. Q.B. to K. Kt. 5.

This is a very good move, as the sequel shows.

6. Q. to K. Kt. 3. 6. Kt. takes K.P.

If, instead of your last move, you had taken Kt. with B., you would have lost the exchange of R. for Kt. Black, by his last move, exposes both his Kt. and Q. to be taken, but whatever you play, he will have the better game.

7. Q. takes B. 7. Q. takes B.
8. Q. takes Kt. 8. Q.to Q.B. 8 (ch.)

If, instead of taking Kt., you had played your Q. to Q. B. 8, checking, Black would have played his K. to K. 2. with a fine game. He has now a piece less than you, but his superior position amply compensates this disadvantage.

9. K. to K. 2.	9. Castles.

If in this position, you take Q. Kt. P. Black plays Kt. to Q. 2, or if you move K. Kt. P., he will play Q. Kt. to B. 3, and then take Q. Kt. P., winning.

NINETEENTH OPENING.

1. K. P. 2.	1. K. P. 2.
2. K. B. to Q. B. 4.	2. K. B. to Q. B. 4.
3. Q. to Kt. 4.	3. Q. to K. B. 3.
4. K. Kt. to B. 3.	4. Q. Kt. to B. 3.
5. Q. to K. Kt. 3.	5. Q. P. 1.

The game may now be considered about equal. Your last move was necessary to avoid the attack from the adverse Q. B., by his playing Q. P. 2.

TWENTIETH OPENING.

WHITE.	BLACK.
1. K. P. 2.	1. K. P. 2.
2. K. B. to Q. B. 4.	2. K. B. to Q. B. 4.
3. Q. to K. R. 5.	3. Q. to K. 2.
4. Q. Kt. to B. 3.	4. Q. B. P. 1.
5. K. Kt. to B. 3.	5. K. Kt. to B. 3.
6. Q. takes K. P.	6. K. B. takes B. P. (ch).
7. K. to B. square.	7. Q. takes Q.

If you had taken B. with K. you would have lost your Q. by Black's checking with Kt. at Kt. 5. You might have moved your K. to Q. square, but with the same result.

8. Kt. takes Q.	8. K. B. to Q. 5.

Black's last move is very good; *Gioachino Greco* is the first author who indicates it.

9. Kt. takes K. B. P.	9. Q. P. 2.

If you had retreated your Kt. to B. 3, Black would have taken Q. Kt. with B., and then K. P. with Kt.

10. Kt. takes R.	10. P. takes B.

You will not be able to extricate your Kt., and consequently must lose the game.

TWENTY-FIRST OPENING.

1. K. P. 2.	1. K. P. 2.
2. K. B. to Q. B. 4.	2. K. B. to Q. B. 4.
3. Q. to K. R. 5.	3. Q. to K. B. 3.

In the preceding opening Black played 3, Q. to K. 2; *Cozio* shows that the one here adopted is quite as good.

4. K. Kt. to B. 3.	4. Q. P. 1.
5. Q. P. 1.	5. K. R. P. 1.

To prevent your playing Q. B. or K. Kt. to Kt. 5, advantageously.

6. K. Kt. to Kt. 5.	6. K. Kt. P. 1.
7. K. B. takes K. B. P. (ch).	7. K. to K. 2.
8. B. takes Kt. P.	8. P. takes Kt.

You should rather have taken that P. with Q.; you would equally have lost a piece, but you would have had three P.'s.

9. Q. B. takes P.	9. R. takes Q.
10. B. takes Q. (ch).	10. Kt. takes Q. B.
11. B. takes R.	11. Kt. takes B.

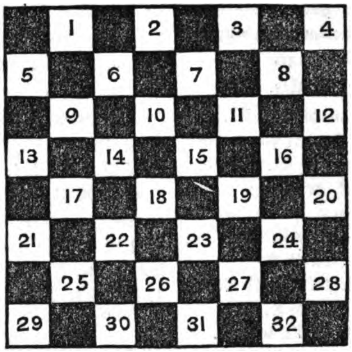
Black has evidently the better game.

VARIATION.

6. Q. B. to K. Kt. 5.	6. Q. to K. Kt. 3.
7. Q. takes Q.	7. P. takes Q.
8. B. to Q. 2.	8. Q. Kt. to B. 3.
9. K. Kt. to R. 4.	9. K. Kt. to K. 2.
10. Q. Kt. to B. 3.	10. K. Kt. P. 1.

Black has the better game, for your Kt. will have to return to the same square, and you will be prevented from advancing your K. B. P., while Black will have an open file for his R's, with which he will form a powerful attack on you.

DRAUGHTS.



DRAUGHTS is a game with a checkered board and men, of much less antiquity than chess, and is perhaps to be considered a degenerate descendant of that noble sport. In France, it is called *les dames*, from having been a favourite game with ladies; and in Scotland this signification is preserved in the term *dam-brod*, the name universally applied by the common people to the draught-board.

Draughts is played on a chess-board, or a board checkered precisely in the same manner, with thirty-two white, and thirty-two black squares. The board, however, is placed before the players differently: in chess there must be a white square in the right-hand corner, but in draughts the right-hand corner must be black—that is, supposing you to play on the white squares. The following is a representation of a draught-board, numbered for the sake of illustration, and placed as it should be in playing.

The game is played by two persons, who sit opposite to each other. Each party has a set of twelve men, the colour of the two being different, for the sake of distinction. The men are generally round and flat pieces of wood; one set white, and another black; those of the neatest kind are turned out of boxwood and ebony.

The men may be placed either on the white or black squares, but the whole must be put on one colour only. It is customary in England to place all upon the white, and to have, as above, a black square on the right. In Scotland the black are played upon, when there is consequently a white square to the right. We go upon the supposition that the play is on the white squares, and have numbered them in the above figure accordingly.

The movements in draughts are very simple: a man can move only one square at a time, and diagonally, never straightforward or sidewise. If an enemy's man stand in the way, no move can take place, unless there be a vacant square beyond into which the piece can be lifted. In this case, the man leaped over is taken; he is removed from the board.

The grand object of the game, then, is to clear the board of the enemy's men, or to hem them in so that they cannot move; and whichever party does so first gains the victory. As no piece can move more than one step diagonally at a time, there can be no taking till the two antagonists come to close quarters; and the pushing them cautiously into each other's neighbourhood is the principal art in the game.

When the men on either side have cleared their way by taking, or found an open path to the opposite side of the board, they become invested with a new power of movement: by reaching the first row of squares on the opposite side, the piece is entitled to be *crowned*, which is done by placing a man on the top of it. Thus crowned, the man may move backward, but always diagonally, and one square at a time, as before. This power of moving, and taking either forward or backward, renders it of consequence to get men crowned; and if two or three on each side gain this honour, the game becomes more interesting, and may speedily be determined.

Immediately after crowning, great art is shewn in blocking up one or more of your adversary's men, by the aid of which to accomplish a series of decisive moves. For instance, supposing you have detained your adversary's piece at 4, while he has others situated on 25 and 26—and supposing you have pieces on 12 and 19, with a crowned man at 14, you may, by giving him your 12 and 19, exchange two pieces for three, which is commonly equivalent to winning the game. Again, supposing you have pieces on 13, 22, 30, and a crowned one on 26, and your adversary a piece on 5, with others scattered in the direction of 16, 8, 7, you may, by successively pushing before him your pieces on 13 and 22, gain a formidable exchange.

In beginning to play, much depends on having the first move; and the rule is, that in playing several games each party takes the first move alternately.

N	C	F	T	N	C	F	T
1	B	11	15	28	W	30	25
2	W	22	18	29	B	29	22
3	B	15	22	30	W	26	17
4	W	25	18	31	B	11	15
5	B	8	11	32	W	20	16
6	W	29	25	33	B	15	18
7	B	4	8	34	W	24	20
8	W	25	22	35	B	18	27
9	B	12	16	36	W	31	24
10	W	24	20	37	B	14	18
11	B	10	15	38	W	16	11
12	W	27	24	39	B	7	16
13	B	16	19	40	W	20	11
14	W	23	16	41	B	18	23
15	B	15	19	42	W	11	8
16	W	24	15	43	B	23	27
17	B	9	14	44	W	8	4
18	W	18	9	45	B	27	31
19	B	11	25	46	W	4	8
20	W	32	27	47	B	31	27
21	B	5	14	48	W	24	20
22	W	27	23	49	B	27	23
23	B	6	10	50	W	8	11
24	W	16	12	51	B	23	18
25	B	8	11	52	W	11	8
26	W	28	24	53	B	18	15
27	B	25	29	&c.	W	loses.	

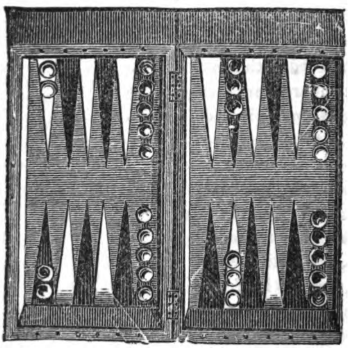
If a player touch one of his men, he must play it. If a player omit to take a man when it is in his power to do so, his adversary can *huff* or *blow* him—that is, either take the man, or insist upon his own man being taken. The practice is at once to lift the man which ought to have taken yours.

We present in the table above an example of playing a game, in which white loses. The letters N, C, F, T, at the head of the columns, signify *Number*, *Colour*, *From*, *To*.

It is not considered fair for any bystander to advise what motions should be taken, or for a player to wait longer than five minutes between each move. The draught-player, therefore, must on all occasions act with much more promptitude and decision than in the case of chess. In short, draughts is a very ticklish game. A single false step may lead to irretrievable ruin; and it is only after long experience in figuring in the mind what would be the result of particular movements that proficiency is attained.

BACKGAMMON.

W



B.

Backgammon is the modern name of a game of considerable antiquity in England, where it was formerly known by the appellation of "the tables." The words *back-gammon* have been ascribed to the Welsh tongue, in which they are said to signify *little battle;* but Strutt, with greater plausibility, traces the term to the Saxon "*bac* and *gamen*—that is, back-game—so denominated because the performance consists in the two players bringing their men back from their antagonist's tables into their own; or because the pieces are sometimes taken up and obliged to go back—that is, re-enter at the table they came from." Whatever be the etymology of the term, the game has been long established in the country; and, as a fireside amusement of a decorous and exciting nature, is a favourite among clergymen, squires, farmers, and retired professional persons.

Backgammon is played with an appáratus consisting of a board or tables, men or pieces, dice, and dice-boxes. The introduction of dice into the game, and their constant use in determining moves, makes backgammon essentially a game of chance, and therefore brings two players of unequal talents nearer a level than other diversions in which skill is the sole or predominant element.

The backgammon board consists of two parts or tables, generally united by a hinge in the middle, by which they can be shut up as a box. Each table possesses twelve points, six at each end. These points are coloured white and black alternately; but this variation of colour has no reference to the game, and is only done to make the points more easily counted.

The game is played by two parties, and with thirty pieces or men; each party has fifteen men, one set of fifteen being black, and the other white. In beginning the game, the men are placed on certain points on the tables, as shown in the foregoing figure.

The game is played with two dice and two dice-boxes. The dice are common to both; but each party uses his own dice-box, and the throws are alternate.

Each dice is a perfect cube, marked on its sides with dots from one to six. The one is called *ace;* the two, *deuce;* the three, *tre*, or *trois;* the four, *quatre;* the five, *cinque;* and the six, *size*. At every throw the two dice are employed; consequently, a person may throw from two up to twelve—that is two *aces* up to two *sizes*.

If a player throw *doublets*, or both dice of one number, double the number of dots is reckoned; thus, by a throw of two aces, the player does not count two, but four.

These numbers thrown, or accidentally turned up by the dice, bear a reference to the points on the tables. In order to understand this connection between the dice and the men, the learner must observe how the men are placed on the points, and the rules by which their shifting from one to another is governed.

The tables are here spread out as if two partners were seated, and about to begin to play. The party owning the white men is seated at W, and the party owning the black men at B. We shall call one party White and another Black. White counts round from the ace-point of Black, and Black counts round from the ace-point of White. These ace-points are respectively seen to have two men upon them in opposite corners of the same table.

The grand object of the game is for each party to get all his men played round into the table containing the aces, removing them from point to point agreeable to the throws of the dice.

In throwing, the number upon each die turned up may be reckoned by itself, or collectively, with the number on the other die. Thus, if quatre be thrown by one die, and size by the other, a man can be advanced four points, and another six points; or one man can be advanced ten points, always providing that a point is open to suit this movement to it. No point can be moved to if covered by two men belonging to the adversary. If covered by only one man, which is called a *blot*, then that man can be hit, and be removed from the point, and placed on the bar between the tables, his place being taken by the man who has won it.

The removal of a man to the bars throws a player considerably behind in the game, because the man must remain out of the play till the dice turn up a certain number corresponding to one open point on the adversary's table. Being fortunate to get an open point by this means, the man must be entered and wrought round from thence, as in the case of others in the set to which he belongs. The frequent occurrence of this hitting of a blot gives an adversary a great advantage, and allows him to win the gammon.

There are two kinds of victory—winning the hit, and winning the gammon. The party who has played all his men round into his own table, and by fortunate throws of the dice has borne or played the men off the point first, wins the *hit*.

The gammon may be explained as follows: When you have got all your men round to your own table, covering every point, and your adversary has a man out, then you are enabled to *bear* or lift your men away. If you can bear all away, so as to clear your table before the adversary gets his man placed by a throw on your table, you win the gammon. If the adversary has been able to bear one before you have borne all your men, it reduces the victory to a hit.

Two hits are reckoned equal to one gammon in playing matches. To win two games out of three is called winning the *rub*, as at whist.

HOYLE'S DIRECTIONS FOR BEARING MEN.—If a player has taken up two of the adversary's men, and happens to have two, three, or more points made in his own tables, he should spread his men, that he either may take a new point in his tables, or be ready to hit the man which the adversary may happen to enter. If he finds, upon the adversary's entering, that the game is upon a par, or that the advantage is on his own side, he should take the adversary's man up whenever he can, it being twenty-five to eleven that he is not hit; except when he is playing for a single hit only; then, if playing the throw otherwise gives him a better chance for it, he ought to do it.

It being five to one against his being hit with double dice, he should never be deterred from taking up any one man of the adversary's.

If he has taken up one of the adversary's men, and should happen to have five points in his own tables, and forced to leave a blot out of his tables, he should endeavour to leave it upon doublets preferable to any other chance, because in that case the odds are thirty-five to one that he is not hit; whereas it is only seventeen to one that he is hit upon any other chance.

When the adversary is very forward, a player should never move a man from his quatre, trois, or deuce points, thinking to bear that man from the point where he put it, as nothing but high doublets can give him any chance for the hit. Instead of playing an ace or a deuce from any of those points, he should play them from his own size or highest points; so that throwing two fives or two fours, his size and cinque points being eased, would be a considerable advantage to him; whereas, had they been loaded, he must have been obliged to play otherwise.

It is the interest of the adversary to take up the player as soon as he enters. The blot should be left upon the adversary's lowest point—that is to say, upon his deuce-point rather than upon his trois-point; or upon his trois-point rather than upon his quatre-point; or upon his quatre-point preferable to his cinque-point—for a reason before mentioned: all the men the adversary plays upon his trois or his deuce-points are deemed lost, being greatly out of play; so that those men, not having it in their power to make his cinque-point, and his game being crowded in one place, and open in another, the adversary must be greatly annoyed by the player.

If the player has two of the adversary's men in his tables, he has a better chance for a hit than if he had more, provided his game is forwarder than that of his antagonist; for if he had three or more of the adversary's men in his tables, he would stand a worse chance to be hit.

When a player is running to save the gammon, if he should have two men upon his ace-point, and several men abroad, although he should lose one point or two in putting his men into his tables, it is his interest to leave a man upon the adversary's ace-point, because it will prevent his adversary from bearing his men to the greatest advantage, and, at the same time, the player will have a chance of the adversary's making a blot, which he may chance to hit. However, if a player finds, upon a throw, that he has a probability of saving his gammon, he should never wait for a blot, as the odds are greatly against his hitting it, but should embrace that opportunity.

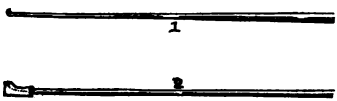
BILLIARDS.

This elegant sport may be said to combine the principles of bowls, golf, and some other games in which objects are impelled from the hand. Whether the game was invented in France or England is not clearly ascertained; but, as it is mentioned by Shakspeare, it is at least as old in this country as the sixteenth century.

Billiards is played with a table, certain kinds of rods, and balls. The table varies in size; that in most common use being twelve feet long, and six feet one inch and a-half in width. Whatever be its dimensions, it requires to be perfectly level and smooth. It is ordinarily made of pieces of slate joined together; and these being brought to a dead level, the surface is covered with fine green cloth. All round is a ledge or cushion two inches high, and stuffed with India-rubber. The table is furnished with six pockets, one at each of the four corners, and one on each side at the middle. The mouths of these pockets or purses are level with the surface, so as to allow the balls to glide easily into them.

The balls are of ivory, varying from an inch and a-half to two inches in diameter. Two are white, and one is red. One of the white is distinguished by a spot. There are usually two players in the ordinary winning and losing game; he who owns the plain ball is called *Plain*, and he who owns the spotted ball is termed *Spot*. The red ball belongs to neither, but is aimed at by both.

The rods or bills used by the players are of two kinds, and different lengths, to suit different players. The ordinary kind of rod is called a *cue*. It is long and smooth, with one end thick and heavy (1), and the other tapered to a point; this is covered with a button of leather. The other kind of rod is termed a *mace;* it has a club-like extremity (2), and is much less frequently used.



Almost all players employ cues of a length and weight to suit themselves.

In playing, the left hand is rested with the palm undermost on the table. The palm is hollowed, and the thumb, close to the forefinger, is raised up to form a bridge or rest for the cue. The hand should be at the distance of about six inches from the ball. The cue is lightly held in the right hand, the blow being struck with the small extremity. Thus held, in a free but firm manner, and resting on the channel between the forefinger and thumb, the cue is given a sharp run forward, so as to hit the ball in the required direction, and with that exact degree of force which will make it perform the desired feat. To prevent slipping, the point of the cue is generally chalked.

The table is laid out as follows for playing the winning and losing game. At the distance of about a foot from one end, in the centre of the table, is a small dot or mark in the cloth, on which the red ball is placed. At twenty-eight inches from the other, which we shall call the upper end of the table, a line is made across by a chalked string; then taking the centre of this line, a semicircle of twenty inches' diameter is drawn from it, between the chalk-line and the upper end of the table. The space enclosed by this semicircle is called *baulk*.

In setting out in a game, the first stroke or lead is determined by lot. This is called *stringing* for the lead. Each player hits his ball from the *string* or line, and he who causes it to rebound from the bottom cushion and come back nearest to the upper cushion, has the lead and the choice of the balls.

The first player begins by striking his ball from baulk against the red ball, as already mentioned; and if he pockets the red ball, he scores three; if both, he scores six, and begins again. So long as he pockets or *scores*, the adversary does not get a stroke. If the player miss, the adversary takes his turn. Both now play alternately, hitting the balls where they chance to lie; but when one pockets his own ball, he starts afresh by striking from baulk. If the player strikes both the red and his adversary's ball, it is termed a cannon, and scores two. The beginner will, however, derive more benefit by studying the rules, than from any description we can offer.

A person in attendance, called the *marker*, *scores* or keeps reckoning of the play. He does this by means of a marking board, which has indicators and two rows of figures—one for Plain, and the other Spot. Technically, when a *point* is gained, he scores one for Plain, or one for Spot.

Winning and Losing Game.

1. The game is twenty-one in number, though sometimes played twenty-four, fifty, sixty-three, one hundred, or more; but twenty-one is the regular game.

2. At the commencement, both persons string for the lead and choice of balls, except when any points are given; then the person receiving the odds plays off at the beginning of the match, and the winner of each game leads afterwards.

3. In stringing, the person who brings his ball nearest the cushion, in baulk, has the option of playing first or not, and choice of balls, except when his ball touches the other or goes into a pocket; in either of which cases the adversary has the option.

4. At the beginning of the game, the red ball is to be placed on the spot at the further end of the table, and replaced there on being put into a pocket, knocked off the table, or when the balls are broken after a foul stroke; but should any ball be on, or so near the spot, as to prevent the red being placed there without touching the other, in that case the red must be placed in the centre of the table.

5. The points of the game are scored as follows:—One point for a miss, two for a cannon, two for a white hazard, three for a red hazard, three for running a coo or knocking your own ball off the table without touching any of the others.

6. A white winning hazard is made when you play at the white ball and pocket it; a white losing hazard, when you pocket your own ball off the white.

7. A red winning hazard is when you pocket the red; a red losing hazard, when you pocket your own ball off the red.

8. A cannon is when your ball strikes the other two.

9. A coo is when your ball goes into a pocket, or jumps off the table without touching either of the others.

10. A four-stroke is made by playing at the white, making a cannon, and pocketing your own or adversary's ball; or you pocket his and your own without the cannon; or by playing at the red, making a cannon, and pocketing your opponent's ball.

11. A five-stroke is made by playing at the red, making a cannon, and pocketing your own or the red; or pocketing the red and your adversary's ball without the cannon; or you pocket your own and adversary's ball off the red; or you play at the white, make a cannon, and pocket the red; or you play at the white, and pocket your own and the red.

12. A six-stroke is made by playing at the red and pocketing it and your own; or striking the white first, making a cannon, and pocketing your own and adversary's ball.

13. A seven-stroke is made by playing at the red, making a cannon, and pocketing your own and adversary's ball; or by playing at the first white, making a cannon, and pocketing your own or adversary's and the red; or by striking the white, and pocketing all the balls without a cannon.

14. An eight-stroke is made by playing at the red ball, making a cannon, and pocketing your own and the red; or if you strike the red and pocket all the balls without the cannon.

15. A nine-stroke is made when you cannon by striking the white first and pocketing all the balls.

16. A ten-stroke is made when you

cannon by playing at the red first, and pocket all the balls. This is the greatest number that can be made.

17. If the striker, in making a cannon or hazard, should by accident touch either of the balls with his cue, hand, or otherwise, the adversary can, if he thinks proper, claim it as foul, and have the balls broken; in which case, the points made by such stroke are not scored, and the person claiming the foul stroke leads off.

18. Foul strokes are made as follows—namely, when the striker's ball touches either of the others; touching any ball while rolling; moving another ball in any way while taking aim or in the act of striking; pushing the balls together when playing with the *butt* of the cue; playing with both feet off the floor; playing at a ball before it has done rolling; or by playing with the wrong ball; in this latter case, should a hazard or cannon be made, the adversary can have the balls broken and lead off; and should no score be made by such stroke, he can take his choice of balls and play.

19. In breaking the balls, you take them all off the table, place the red on the spot, and both parties play from the baulk.

20. If the balls have been changed, and it cannot be ascertained by whom, the game must be played out with them as they then are; or even if two strokes have been made before the mistake is discovered, it must still be played out in the same way.

21. Should the striker, in making a cannon or hazard, knock his own or either of the balls off the table, he cannot score the points made by such stroke, and the opponent plays, but the balls are not broken.

22. If a ball stops on the edge of a pocket, and afterwards falls in, either by shaking the room, table, or other accident, it must be replaced as near the original place as possible.

23. Should the striker, when in hand, play at a ball in baulk, his adversary has the option of scoring a miss, or having the balls replaced, and the stroke played again, or of breaking the balls.

24. If the striker's ball touch another, he must play, and should he make a cannon or hazard, the adversary can claim it as foul, or he can allow points to be scored and the person to play on; but should the striker not score, it is at the option of the opponent to break them or not.

25. Should the marker, whilst marking for the players, by accident, touch either of the balls, while rolling or not, it must be placed as near as possible to the place it would have occupied.

26. If the last player should alter the direction of the balls while rolling, with cue, hand, or otherwise, the striker may place it where he thinks proper.

27. A line-ball is when either the white or red is exactly on the line of the baulk, in which case it cannot be played at by a person whose ball is in hand, it being considered in baulk.

28. If the striker's ball is over the pocket, and he should, in the act of striking, miss it; but, in drawing his cue back, knock it into the pocket, he will lose three points, it being a coo.

29. If the red ball has been put into a pocket, it must not be placed on the spot till the other balls have done rolling; should there be a probability of either of them touching it again, as the stroke is not finished till the balls stop.

30. If the striker should touch his ball

by accident when taking aim, it is not a stroke, and the ball is to be replaced; but should he touch it in the act of striking, then it is a stroke.

31. If either of the balls lodge on a cushion, it is off the table, and should a cannon or hazard be made, it does not score, and the ball must be placed on the spot, or played from the baulk, according to what ball it is, white or red.

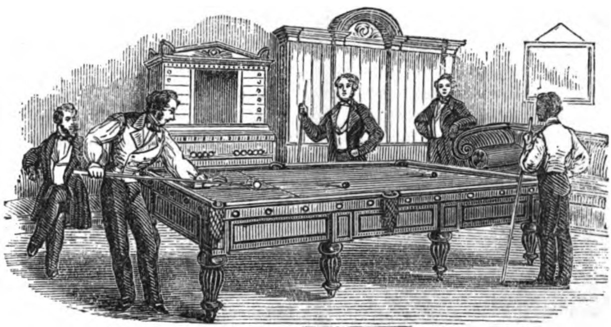
32. Any person refusing to play the game out after he has played one stroke, loses it.

33. In a match of four, the game is thirty-one, and each person is at liberty to offer his partner advice.

34. All disputes in the game to be decided by the marker or majority of the company; but no person has a right to interfere until appealed to by one or both players.

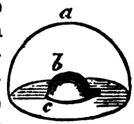
35. It is a love-game when no hazard has been made by the loser.

36. All camp-games are played sixteen up.

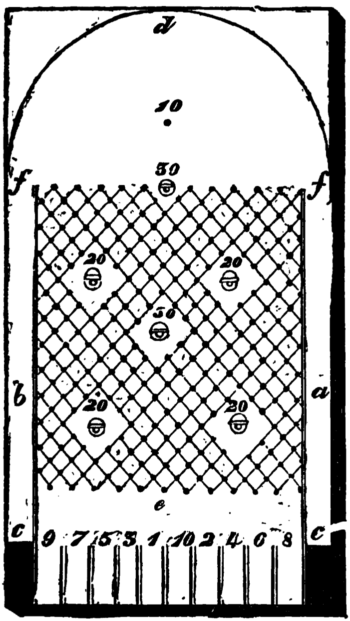


TIVOLI, OR CHINESE BILLIARDS.

This is a very interesting game, and is easily played. The board with which you play varies in length from 2 feet 6 inches, to 4 feet or upwards, and is shaped as shown in the accompanying figure. It may be easily made by any ingenious person, by attending to the following directions:—Partition off a space on each side of the board (*a b*) sufficiently wide for the marble or ball with which you play, to run freely along. Place a piece of wood, about 3½ inches in length, at the lower end of each passage (*c*), and fix it an angle of about ten degrees. Divide the space between the two passages at the lower end (*e*) into ten compartments, and paint a number before each, in the order observed in the figure. Six spaces are to be left in the board for the marbles or balls to drop into, and these are to have a central portion sunk in the board (as *c* in the annexed figure), into which the marble or ball (*b*) drops; a wire (*a*) is bent over the circle so as to form an arch, and proper numbers are to be painted before each, as shown in the figure. A small dent is



to be made in the board, midway between the 30 resting-point and the arch of the board, and 10 painted in front of it. The space between the two passages (*a b*) must



be ruled into a diamond-shaped pattern, as seen in the figure, each diamond measuring one inch on all its sides, and when this is done, the lines must be painted black, and a thick pin driven into each of its angles (indicated by a dot in the figure). It now only remains to finish the board by affixing a thin piece of wood (*d*), which extends from *f* to *f*, and to provide two balls or marbles, one dark and the other white, and two small cues or tapered sticks, with which the game is played.

Before the game is commenced, the upper end (*d*) of the board must be slightly elevated (about two inches) from the table

RULES.

1. Any number of persons may play, and if more than two, sides, or partners, are to be chosen.

2. The number of the game is previously agreed upon by the players, being sometimes fixed as low as 2,000, or at 10,000, or 30,000.

3. The dark ball counts ten times the number into which it falls. For example: if it lodges in 50 cup, it counts 500, and so on.

4. The white ball only marks those numbers into which it falls.

5. If a ball lodges against a pin, the player striking the ball does not mark anything.

6. If a ball makes the circuit of the board, that is, from *c* on one side to *c* on the other, the player loses 10.

7. If a ball is not struck with sufficient force, so that, instead of leaving the passage, it returns again to the starting-point, *c*, the player loses 10.

8. The choice of first-player is decided by the highest number obtained by the first throw, the winner to have the option of scoring the number.

9. The player who obtains the highest number first, wins the game.

AGON, OR THE QUEEN'S GUARDS;

A NEW GAME OF SKILL.

This game possesses greater interest and more scientific combinations than Draughts, with less intricacy than Chess.

The estimation in which the games of Chess and Draughts have been held for years by thousands, renders it unnecessary to offer any remarks upon the advantages arising from games of skill, as affording a healthful and amusing intellectual relaxation.

Every one experienced in the game of Draughts, is aware, that after a few moves it is almost always possible to say which player will eventually win the game: hence, first-rate players, to have the necessary excitement to play, give the first move, which, to two good players, is, in this game, of importance, besides one or two pieces to less experienced players; in truth, a readiness in determining which player has the move, as it is called, over any particular piece, furnishes a key to almost every variety which can be made in the game.

With respect to Chess—"pensive Chess"—as the poet has designated it—the heavy forward step of its Rook, the sprightly, skipping step of its Knight, the solemn diagonal step of its Bishop, the unlimited step of its Queen, the slow, stately step of its King, and the short, restrained step of its pawns, with the amazing variety of combinations thence arising, must for ever render the game the favourite study and delight of the thoughtful philosophic mind, that can calmly contemplate the mysterious field, and see order reign amidst seeming confusion; but to the general ordinary mind the game must be as a sealed book. A game that may occupy a medium state between these two celebrated games, may, therefore, be considered as a desideratum; such a one, it is presumed, will be found in the game Agon. In this game no advantage will be obtained or lost by having the first move, and it will be impossible for any player to determine which has the advantage until the game may be fairly considered to be won.

In variety of situations the game will be found almost to equal Chess, and from the mathematical figure of the board (being a combination of Hexagons), many symmetrical situations may be devised, and the game played from these particular positions, thus affording an endless variety of amusement.

The celebrated Dr. Franklin has enumerated the morals of Chess; in this respect, the game of Agon possesses no inconsiderable merit, as precipitation and over-eagerness to obtain the middle, will, on all occasions, be attended with the loss of the game: hence circumspection and prudence will be instilled.

The petty warfare of giving piece for piece, usually practised in other games, has no resemblance in this, the game being won by a position, and not by the removal of the pieces off the board; hence every piece is of equal importance throughout the game, and a habit of regarding not one, but all, is gradually acquired, thereby showing the advantages of concentrated exertion over individual competition.

Unity of action is always necessary for success in every undertaking; this lesson the game of Agon will be found constantly to inculcate. Unless all the pieces are so posited as to act simultaneously at the decisive moment for winning the game, all previous labour is lost; and one piece forgotten, or left too far off to act effectively, renders it impossible to attain the object.

The word Agon is derived from a Greek word signifying a *combat* or *contention;* from the same source are derived the following words now considered to belong to the English language: *Ant-agon-ist*, a contender against; *Agon-y*, the conflict arising from excessive pain either of body or mind; and *Agon-ist-es*, a prize-fighter.

DIRECTIONS FOR PLAYING.

Each player has seven pieces, viz., one Queen and six Guards.

To commence the game, the pieces are to be arranged as follows:—

Put the two Queens on two opposite corners, and the Guards on each side of the Queens, each colour alternate, with one hexagon left vacant between each piece (two hexagons will be vacant on each side farthest from the Queens.) See Fig. 1.

If the players so agree, the game may be commenced by each alternately placing a piece anywhere on the board, and then, when all the pieces are laid

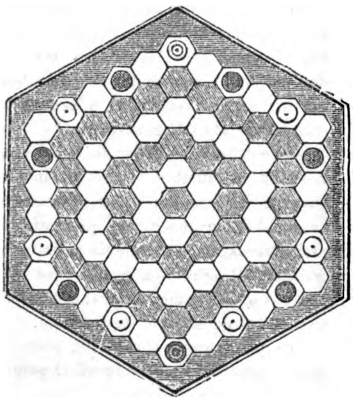


Fig. 1.
READY TO COMMENCE THE GAME.

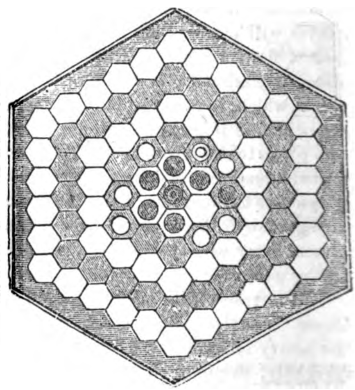


Fig. 2.
THE DARK PIECE BETWEEN THE TWO LIGHT ONES STANDING IN A RIGHT LINE MUST BE PUT BACK.

down, each alternately moving forward to obtain the middle.

Having decided which shall move first, the players alternately move a piece towards the centre, one hexagon at a time, or to the next hexagon of the same colour, so that the piece shall remain at the same distance from the centre, it not being allowed to move a piece backward.

Any piece, except the Queen, being in a position between two of the adversary's, so that the three pieces form a straight line, must be taken off the board for the next move, and put down anywhere in the outer row. See Fig. 2.

If the Queen should be placed in the position between the adversary's so that the three pieces form a straight line, the Queen must be removed for the next move, but may be put in *any place*, being vacant, the player pleases. See Fig. 3.

That player who can first put all the pieces in the middle, that is, the Queen in the centre and the six guards around her, wins the game. See Fig. 4.

The players, being supposed to be sitting opposite each other, have the Board placed with two corners right and left of each, and if the pieces have been placed as in Fig. 1, the colour of those pieces the Queen of which is on the right hand, is to be taken by each player.

Two experienced players may put the pieces in a particular position, symmetrically or otherwise, and, each taking the colours alternately, endeavour to win the game.

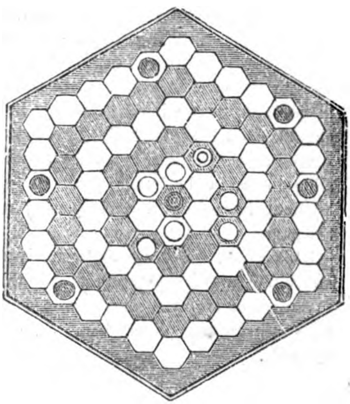


Fig. 3.

THE DARK QUEEN, BEING IN A RIGHT LINE BETWEEN TWO LIGHT PIECES, MUST RETIRE.

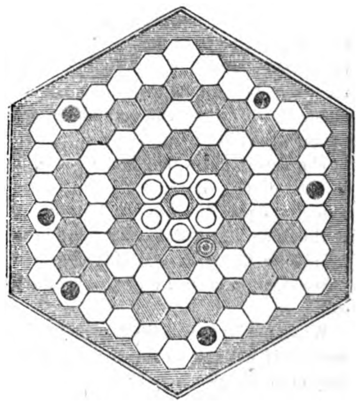


Fig. 4.

THE GAME WON BY THE LIGHT PIECES.

LAWS OF THE GAME.

I. None but the Queens are to occupy the centre.

II. No piece must be put between two of the adversary's standing in a right line.

III. No piece must be moved backwards.

IV. Of two or more pieces liable to be put back at one time, the Queen must be first moved off; any others at the player's option.

V. Any piece touched must be moved, or the move lost.

VI. Should the player put the six Guards in the middle, leaving out the Queen, such player loses the game by forfeit, as both are prevented from accomplishing the ultimatum of the game.

HINTS TO PLAYERS.

No advantage will be gained, but, on the contrary, frequently a loss, by throwing back one only of the adversary's pieces, as the piece thrown back may be placed so as more readily to obtain a much better position than that thrown back from.

As no piece is allowed to move backward, the Queens must not be moved into the centre too hastily, as when there (having no move unless thrown out) their usefulness is impaired.

The player should endeavour to obtain such a position as to be able to throw back several pieces by following moves, and then move on to the middle before the adversary can overtake or get between the pieces.

The surest mode to win the game, is to crowd the adversary's pieces as quickly as possible towards the middle, at the same time taking up a position to be able to throw back all his pieces in succession as soon as an opportunity offers.

When a player has the Queen in the middle, if not able to win the game, he may often re-open it by bringing a piece against the adversary's, so that if his Queen should be thrown back, he may throw back another piece in return; hence, in throwing back the Queens, the greatest caution is always necessary.

The player will generally find it advantageous to have one piece at a greater distance from the centre than any of the adversary's; it must, however, be in a position to get to the middle when the game is drawing to a conclusion.

The position shown in Fig. 2 is certain loss of the game to the dark pieces, the light pieces having forced the dark Queen to move into the centre, will be able to throw back a dark piece every move, and thus win the game; but should the light pieces be moved too early into the middle, it will be impossible to throw back the dark Queen without hazarding the re-opening of the game.

This game, which we first perceived exhibited in the Crystal Palace, is the invention of Mr. A. Peacock, who supplies boards and pieces from 3s. 6d. upwards.

MORRICE MERELLES, OR NINE MEN'S MORRICE.

The game of Merelles, or Morrice, is a game of some antiquity, and was formerly called in England Nine Men's Morrice, and also Five-penny Morrice.

We are informed by antiquaries, that it was formerly played with stones in England, and with pawns, or men, made on purpose, in France; and as these pawns were termed *merelles*, the game was henceforth termed Merelles.

The accompanying illustration shows the form of a morrice-board, or table, improved from that used in the fourteenth century, the lines, however, being the same.

To make a board, have a piece of

wood or cardboard of any shape, and then paint or rule the central part in the manner shown; the black spots at every angle and intersection of the lines being the places for the men to be laid upon.

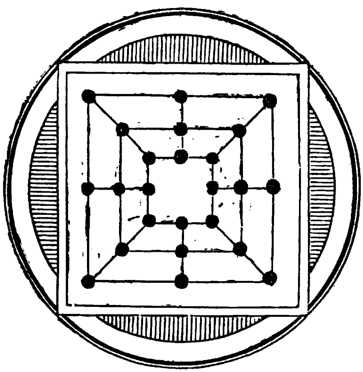
The men are 18 in number, nine white, and nine black or coloured.

RULES.

1. Two persons play at this game, each having nine pieces, which they place alternately, one by one, upon the spots.

2. The great object is to make rows of three men in a line, and to prevent your adversary from doing the same. Three men make a row if placed in a straight line; and, if strict attention is given to the arrangement, one man will form a part of two rows; as when it is placed at the angle.

3. When your adversary has nearly made a row, interpose one of your own men; but if after all, your adversary succeeds in making a line, you forfeit a man, which is then removed from the board; but in doing so, your adversary must not break one of your rows if it can be avoided, but the piece removed



must be from that part which is most likely to benefit you, without breaking a row.

4. When all the pieces are laid down, the players begin to move, but not before.

5. All moves must be made backwards and forwards in the direction of the lines, but only from one spot to another each time; this must be strictly observed.

6. While moving, still endeavour to make rows by moving the men to different parts of the board, so as to interrupt your adversary.

7. When you complete a new row, you can remove, and lay aside, one of your adversary's men.

8. When your adversary's men are reduced to two—not before—you win the game, as three are necessary to form a row.

THE GRASSHOPPER AND THE ANTS.

This is an excellent amusement for a juvenile company. In the first place, lots are drawn to decide which one of the company will take the part of the grasshopper, all the rest being termed ants. The grasshopper, when thus appointed, writes with a pencil, on a piece of paper, the name of some edible grain, then, folding the paper in her hand, goes to the ants, who are seated in a circle, and making a most respectful obeisance, says:—"My dear friends and good neighbours, I am very hungry, I pray you give me some food." Then, particularly addressing the first ant, she continues—"You, my dear, who are so very charitable, what will you give me?" The ant replies, "I have only a grain of rice (or any other grain), which is at your service." The grasshopper then says—"Thank you, my dear," and passes to the next ant, and the others in succession. If none of the ants mention the grain written on the paper which the grasshopper holds, the latter pays a forfeit, and the game is again commenced in its second stage, as will be presently explained; but if one of the ants pronounces the fatal word, the grasshopper says—"I accept your offer, my kind neighbour; may Heaven reward you!" and, showing the paper with the same word, the grasshopper takes the place of the ant, and the latter, paying a forfeit, becomes the grasshopper.

In the second stage of the game, the newly-made grasshopper writes the name of a dance on a piece of paper, and says to the ants—"My kind friends, thanks to your benevolence, my hunger appeased, and now I wish to dance; what dance would you recommend?" The ants, interrogated in succession, mention several dances, as the waltz, polka, minuet, &c., until one, naming the dance written on the paper, is compelled to pay a forfeit, and becomes the grasshopper.

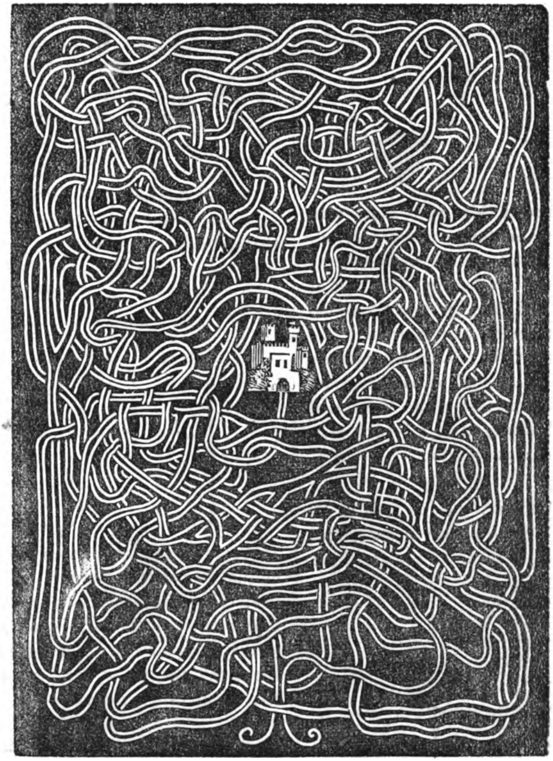
The third grasshopper then writes the name of a musical instrument on the paper, and says to the ants—"My friends, I am much obliged for your kindness, but as I dislike dancing without music, what instrument would you advise?" The ants in turn mention the harp, violin, piano, &c., until the instrument written down is mentioned, and the result is as in the preceding instances.

The next grasshopper says—"I have danced until I am tired, and now wish to go to sleep; under what leaf would you advise me to make my bed?" Each ant, interrogated in turn, replies by naming the leaf of some flower, and the game goes on as before.

The next grasshopper says—"I have slept well, though I dreamt that a bird flew away with me; pray tell me what kind of bird it was?" The ants then, in turn, reply the blackbird, robin, linnet, &c., and thus the game is continued. By the simplest variation in the grasshopper's questions, such as—"What books would you advise me to read?" "What coloured dress would you advise me to wear?" the game can be carried on as long as the players desire.

The amusement of this game is greatly enhanced by the ingenuity of those engaged in it, and the pertinence of the interrogations bearing on the natural history of grasshoppers and ants.

PRACTICAL PUZZLES.



1.—PUZZLE MAZE.

2.

Twenty lines upon paper place,
On every line five circles trace;
These circles should just in amount,
Or number, thirty-seven count;
And every circle, orb, or round,
Upon an angle should be found
At an equal distance too, should be
Upon each line—solve this for me?

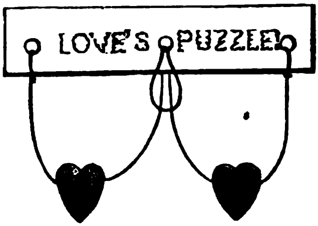
3.

Draw three rabbits, so that each shall appear to have two ears, while, in fact, they have only three ears between them.

4.

Draw a circle upon a piece of paper, and thrust a pin through it without crossing the circle, or thrusting it downward through the centre.

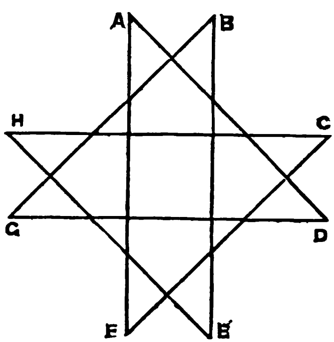
5.



Cut a piece of thin wood about four inches long and three quarters broad. Perforate it with three holes. Cut pieces of bone, cork, or wood, in the shape of two hearts, and then arrange the whole upon strings, as in the diagram. The puzzle is, to get the two hearts upon the same loop. It is a good puzzle for lovers, and suggests the idea of the "union of hearts," of which, when solved, it may be considered a prognostic.

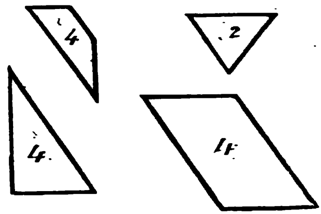
6.

Construct a figure such as A, B, C, D, E, F, G, H, and get seven flat pieces of wood. It is required to place them



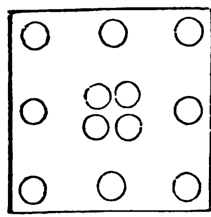
on the points A, B, C, D, E, F, G, H, by sliding them up the lines, as from G. to E to H, &c.

7.



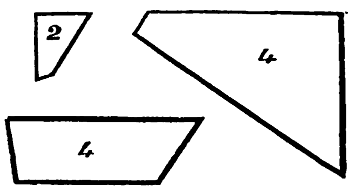
Cut out fourteen pieces of paper, card, or wood, of the same size and shape as those shown in the diagram, and then form an oblong with them.

8.



Prepare a square piece of card-board of the size of the diagram, and punch twelve holes in the position shown. The puzzle is to cut the card-board into four pieces of equal size (each piece to be of the same shape) without cutting into any of the twelve holes.

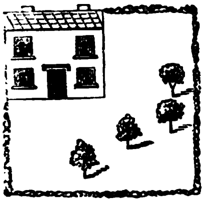
9.



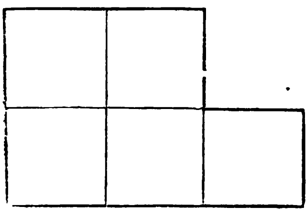
Cut out ten pieces of card or wood, of the same size and shape as in the diagram, and then form a square with them.

10.

I have a square plot of ground, in one quarter of which I have built a house, which I have let to four tenants. I tell them that if they can divide the remaining ground into four equal plots, alike in shape, and each containing one of the four apple-trees I have planted, they shall have it without any increase of rent. How may they succeed?



11.

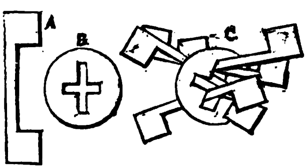


Take a piece of card of the shape and proportions of the above, cut it into three parts, and with these form a perfect square.

12.

THE DOUBLE-HEADED PUZZLE.

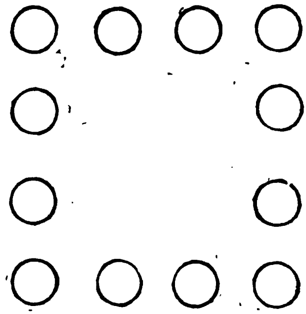
Cut a circular piece of wood as in the cut A, and four others, like B. The



puzzle consists in getting them into the cross-shaped slit, until they look like C.

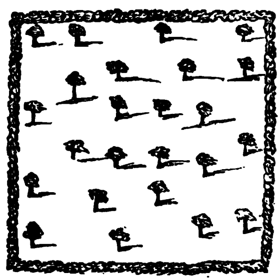
13.

Make a square with twelve counters, having five on each side.



14.

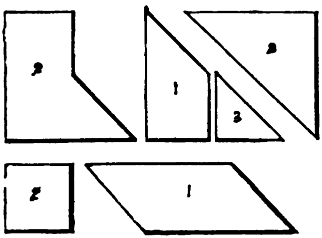
I have just bought an acre of land,
  Containing two dozen fine trees;
And think about having it planned,
  In a style that is likely to please.
In fact I have had it marked out,
  Preserving six trees in a row;



Which I cannot call winding about,
  Nor term a direct line, although
In one sense, they really are straight;
Now, if you divide the same ground
Into four equal parts, you can state
  Or affirm that my argument's sound.

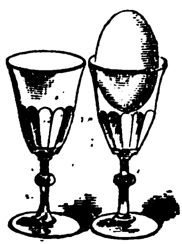
15.

Cut as many pieces of each figure in cardboard as they have numbers



marked on each; then form the pride of the British army with them.

16.



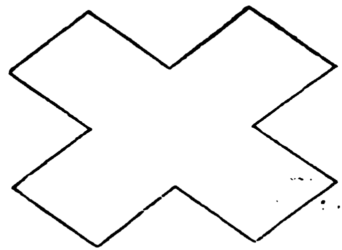
Transfer the egg from one wine-glass to the other, and back again to its original position, without touching the egg or glasses, or allowing any person or any thing to touch them.

17.

Place eight counters or coins, as in the diagram; it is then required to lay them in four couples, removing only one at a time, and in each removal passing the one in the hand over *two* on the table.

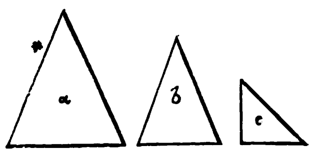
18.

Cut a piece of card-board into the form of, and of equal proportions to, the figure given below, after which, pro-

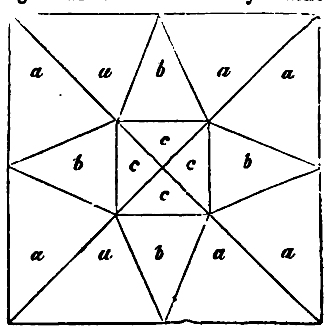


duce, with the same, three successive angular boxes alternately bearing the number of 7, 6, and 5 corners, still keeping the cardboard in one piece.

19.



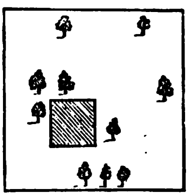
With eight pieces of card or paper, of the shape of fig. *a*, four of fig. *b*, and four of fig. *c*, and of proportionate sizes, form a perfect square. The following diagram will show how this may be done.



20.

Now, sir, your coat is off!
And see—
Your right hand pocketed!
So let it be:
While o'er your arm
An endless string—
Some three yards round—
Hangs like a sling.
Take the string off—
But, just for fun,
It must be done—
Keeping your right hand in its place,
And not a smile must stir your face.
Until you find this puzzle out,
No coat shall wrap your back about.

21.



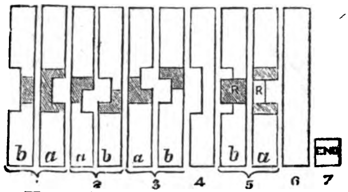
I have a lodging-house in which there are five boarders, all of whom have applied to me to let them cultivate the garden, but they require me to divide the ground around the house into five portions of the same shape and size, giving each two trees. Unless I can do it, I fear I shall offend my lodgers.

22.

Get a bottle full of water, with the cork driven tightly in, and the top of it level with the neck of the bottle. You must remove the cork from the bottle without touching the cork with anything, and without injuring the bottle.

23.

THE CHINESE CROSS.



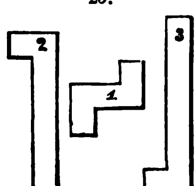
Have six pieces of wood, bone, or metal, made of the same length as No. 6, in the above figures, and each piece of the same size as No. 7. It is required to construct a cross, with six arms, from these pieces, and in such a manner that it shall not be displaced when thrown upon the floor.

The shaded parts of each figure represent the parts that are cut *out* of the wood, and each piece marked *a* is supposed to be facing the reader, while the pieces marked *b* are the *right* side of each piece turned over *towards* the left, so as to face the reader. No. 7, represents the end of each piece of wood, &c., and is given to show the dimension.

24.

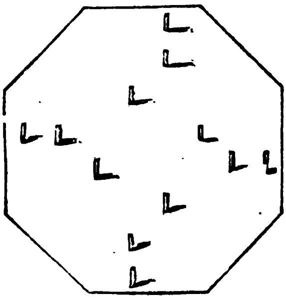
Make eight squares of card, then divide four of them from corner to corner, so that you will now have twelve pieces. Form a square with them.

25.



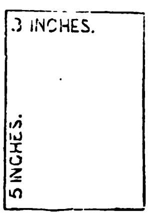
With three pieees of card-board, of the shape and size of No. 1, and one each of Nos. 2 and 3, form a cross.

26.



I have a piece of ground, which is neither square nor round,
But an octagon; and this I have laid out
In a novel way, though plain, in appearance and retain
Three posts in each compartment; but I doubt
Whether you discover how I apportioned it, e'en tho'
I inform you 'tis divided into four.
But, if you solve it right, 'twill afford you much delight.
And repay you for the trouble, I am sure.

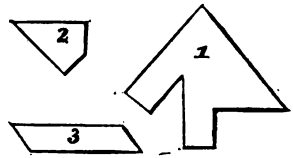
27.



Take a piece of card-board or leather, of the shape and measurement indicated by the diagram. Cut it in such a manner that you yourself may pass through 'ill keeping it in one piece!

28.

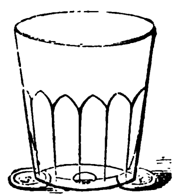
Upon a piece of card-board draw
The three designs below;
I should have said of each shape four,
Which, when cut out, will show,
If joined correctly, that which you
Are striving to unfold—
An octagon, familiar to
My friends, both young and old.



29.

A plank was to be cut in two; the joiner cut it half through on each side, and found he had two feet still to cut; how was it?

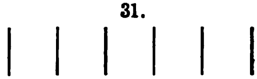
30.



A CAPITAL PUZZLE AT THE DINNER-TABLE

Lay a sixpence between two half-crowns, and place upon the larger coins a glass, as in the diagram. Remove the sixpence without displacing either of the half-crowns or the glass.

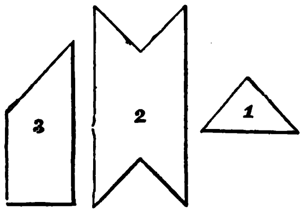
31.



Draw six vertical lines as above, and by adding five other lines to them, let the whole form nine.

32.

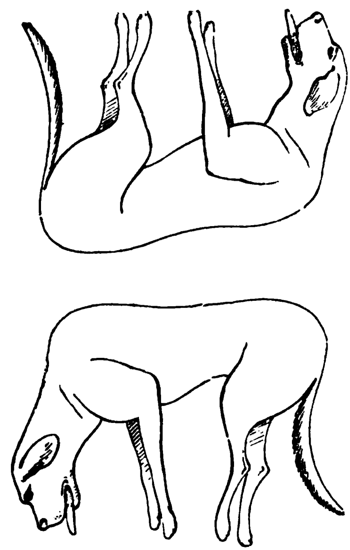
Cut three pieces of paper to the shape of No. 1; one as No. 2, and one as No. 3. Let them be of proportionate



sizes. Then place the pieces together, and form that which, viewed mentally, comforts the afflicted.

33.

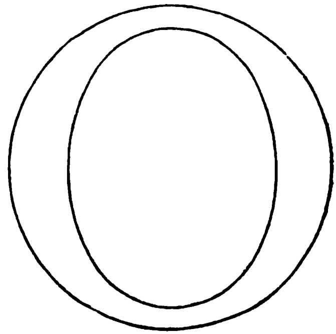
DEAD OR ALIVE.



These dogs are dead you well may say:—
Add four lines more, they'll run away!

34.

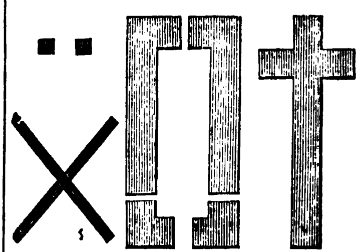
With a piece of stiff paper or card-board, form a complete circle; cut the same into eight parts, and with them produce two perfect ovals; the figures, large or small, should be in proportion to those given below.



35.

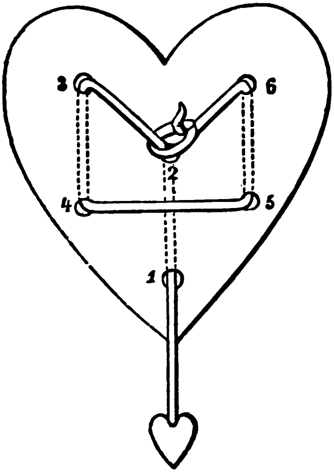
THE PUZZLE OF THE CROSS.

Cut out of a single piece of paper, and with *one cut of the scissors*, A PERFECT CROSS, and all the other forms in the following engraving:—



36.

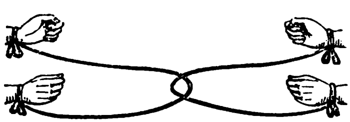
Cut a piece of thin wood the shape in-dicated by the diagram, and having per-forated it as above, draw a piece of string, with a smaller heart attached at the end, through No. 1, pass it behind,



and bring it through 2 before, and through 3, and so on to 6, when a loop must be made so as to enclose that part of the string which runs from 2 to 3. The puzzle is to remove the string from the large heart altogether, without unfastening the loop.

37.

Having tied two strings to the wrists of two persons, and intersected them, as



in the diagram, release the parties without untying either of the strings.

38.

Procure six cards, and having ruled them the same as the following diagrams, write in the figures neatly and legibly.

It is required to tell the number thought by any person, the numbers being contained in the cards, and such numbers not to exceed 60.—How is this done?

3	5	7	9	11	1
13	15	17	19	21	23
25	27	29	31	33	35
37	39	41	43	43	47
49	51	53	55	57	59

5	6	7	13	12	4
14	15	20	21	22	23
28	29	30	31	36	37
52	38	39	44	45	46
47	53	54	55	60	13

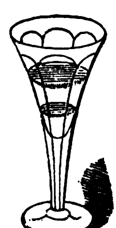
9	10	11	12	13	8
14	15	24	25	26	27
28	29	30	31	40	41
42	43	44	45	46	47
56	57	58	59	60	13

3	6	7	10	11	2
14	15	18	19	22	23
26	27	30	31	34	35
38	39	42	43	46	47
50	51	54	55	58	59

17	18	19	20	21	16
22	23	24	25	26	27
28	29	30	31	48	49
50	51	52	53	54	55
56	57	58	59	30	60

33	34	35	36	37	32
38	39	40	41	42	43
44	45	46	47	48	49
50	51	52	53	54	55
56	57	58	59	60	41

39.



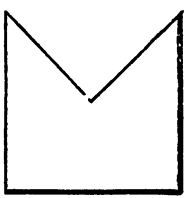
Place a sixpence in the bottom of a glass, and over the latter put a half-crown, as in the diagram. The puzzle is to remove the small coin from beneath the larger one, without touching either of the coins, or touching or upsetting the glass.

40.

Suppose a certain lord had eight apple-trees around his mansion, around these eight houses of his tenants, around these ten pear trees.—he wants to have

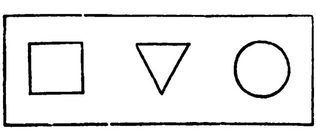
the whole of the pear-trees to himself, and allot to each of his tenants one of his apple-trees in their place. How must he construct a fence or hedge to accomplish it?

41.



Divide this figure into four equal parts, each of the same figure.

42.



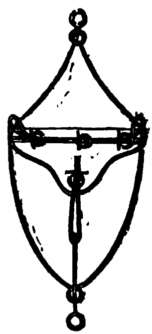
Cut a piece of card-board about four inches long, the shape of the diagram, and make three holes in it as represented. The puzzle is to make one piece of wood pass through, and at the same time exactly fill each of the three holes.

43.

In the centre of a piece of leather make two parallel cuts with a pen-knife, and just below, a small hole of the same width, then pass a piece of string under the slip, and through the hole, as in the figure, and tie two buttons, much larger than the hole, to the ends of the string. The puzzle is, to get the string out again without taking off the buttons.

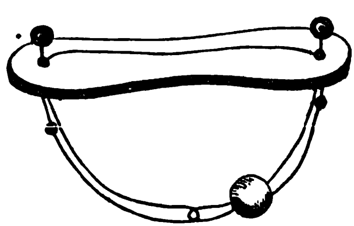
44.

PUZZLE PURSE.



With a piece of Morocco, or any other suitable material, let a purse be constructed similar to the one given below. The puzzle is to open the same without removing any of the rings.

45.



The trick is to get the large ball off the string without untying it, or removing any of the smaller balls.

46.

Cut seventeen slips of paper or wood of equal lengths, and place them on a table, to form six squares, as in the

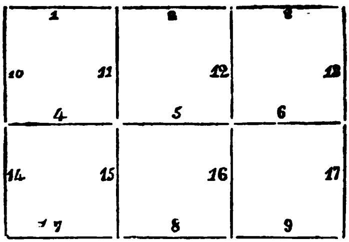


diagram. It is now required to take away five of the pieces, yet leave but three perfect squares.

47.

PRACTICAL CHESS PUZZLE.

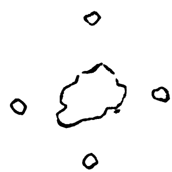
1	2	3	4	5	6	7	8
9	10	11	12	13	14	15	16
17	18	19	20	21	22	23	24
25	26	27	28	29	30	31	32
33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48
49	50	51	52	53	54	55	56
57	58	59	60	61	62	63	64

A Chess Piece, called the Knight, has the power of moving—say from black square 59, to white square 53, 44, 42, or 49; then from either of these white squares to a black square in the same manner; always in moving, there being three squares included in the move, passing corner-ways over one point of union (as from 59 to 52), and square-ways over another (as from 52 to 54); or square-ways first, and corner-ways second; as from 59 to 51, thence 51 to 42. Having learnt this move, which is simple, though not easily described, it is required to lay a wafer, or bit of paper, on each square of the board, of which there are 64, and then to clear them all by 64 moves with the Knight, taking off the piece of paper upon each square the Knight moves to. The puzzle is, to accomplish this in 64 moves, in strict accordance with the Knight's power.

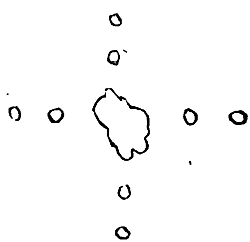
48.

THE PUZZLE WALL.

Suppose there was a pond, around which four poor men built their houses, thus:—



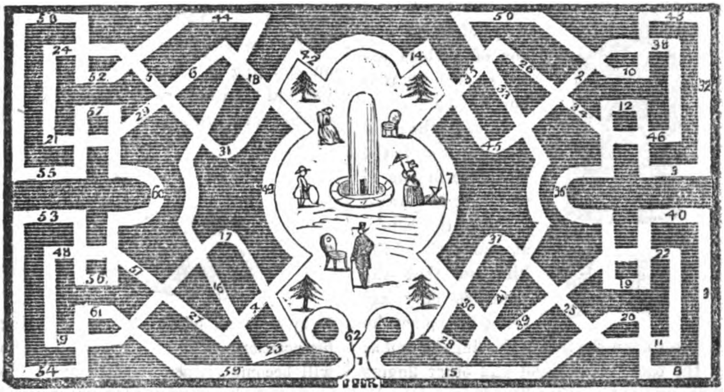
Suppose four evil disposed rich men afterwards built houses around the poor people, thus:—



and wished to have all the water of the pond to themselves. How could they build a high wall, so as to shut out the poor people from the pond

49.

PUZZLE PLEASURE GARDEN.



By aid of hoe and rake and spade,
And perseverance too—I've made
A pleasure garden—and a view
Of the self-same, I send to you.
Within this piece of fancy ground,
Which by a wall's encompassed round,
Are zig-zag walks, both plain and neat,
That leads unto a calm retreat;
And all who would an entrance find,
Should this observe, and bear in mind,
They *once* and *only once* must tread
O'er *every* path—'round every bed
Of plants and flowers that deck this maze
In which a fountain freely plays.
Now those who may, with firm resolve,
This little puzzle truly solve,
And to the fount admittance gain,
May at their pleasure there remain,
And then retrace their footsteps oe'r
Till they regain the garden door.

THE SCOTCH PIPER.

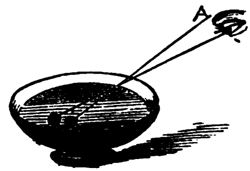
Draw a design upon cardboard, similar to the annexed engraving. Then cut it out neatly with a pair of scissors, and gum a piece of black cloth or velvet over the part intended as the cap; attach two pieces of China ribbon to the side of the cap, and gild or paint the epaulettes. Sew a small band of tape or webbing to the back part of the kilt, large enough to allow the two fore-fingers to pass through it; and when this is done, gum a portion of tartan over the lower part of the design, so as to represent the kilt, and otherwise ornament the figure so that it may represent a Highland piper.

If the whole figure is only intended to be painted, the band at the back of the kilt must be glued on instead of sewing it. Thus far the figure is complete, and you must now make the boots, which may be easily done from a piece of plaid ribbon or stuff, and some black cloth, leather, or velvet. Take care that they are large enough to admit the tips of your fingers at the tops, which should be ornamented with some strips of China ribbon of various colours. The figure is now finished.

To make the piper dance, introduce the two fore-fingers of the right hand through the bands, at the back of the kilt, so that the knuckles only are seen; then place the boots upon the tips of the fingers, and as the back of the hand and other fingers are concealed, the Scotchman may be made to dance, by moving the fingers in such a manner that the knuckles are bent during the performance.

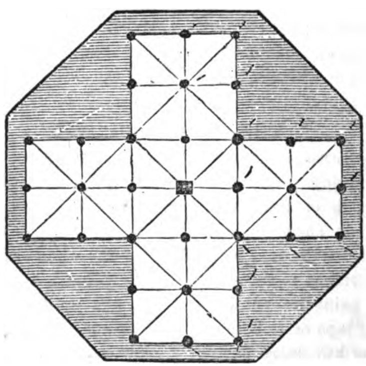
THE INVISIBLE COIN MADE VISIBLE.

If a coin be placed in a basin, so that on standing at a certain distance it be just hid from the eye by the rim or edge of the basin, and then water be poured



in by a second person, the first keeping his position; as the water rises the coin will become visible, and will appear to have moved from the side to the middle of the basin.

FOX AND GEESE.



TAKE a piece of well-seasoned wood, about nine inches square, and cut off the corners, so as to make it octagonal; then draw, cut into the wood, and afterwards ınt, or simply paint the figure shown the accompanying diagram, and bere ıole at the junction of the lines, as in- ated by the 's and ●'s in the figure. t four or eight small feet to the board, l then prepare the eighteen men.

The men are divided into seventeen geese and one fox, the latter of which is distinguished by its size and colour. The men may be cut out of a piece of wood, and should be somewhat like the annexed figure and size. They may be turned for a few pence.

Instead of having a wooden board, the above figure may be drawn upon a piece of cardboard, and chequer or draught-men used instead of the others, distinguishing the by placing one man above the other, same as a king in draughts.

ometimes this game is played with een men instead of eighteen, viz., ·en geese and one fox.

/hen about to play, arrange the fox he centre of the board, as indicated he square black mark, and the geese ıe stations or points marked thus, ●'; if seventeen men are used, the two extra geese must be placed in the two blank points, ⊙.

The fox can move both ways, either backwards or forwards; the geese can only move forward, in the direction of the right lines, but they cannot pass over two spots at one time.

The object of the game is, for the geese to pen up the fox so that he cannot move, and for the fox to reduce the number of the geese by taking as many as he can, which he does by jumping over every one that has a point or hole before or behind him that is not filled up.

The geese cannot take the fox if he stands close to them; but the fox may always take the geese, provided there is a blank point before or behind it as described above.

Neither fox or geese can move more than from one point to another at a time, unless previously agreed upon, and they must always keep along the line.

If a skilful player has the geese, the fox is almost sure to be penned up, and therefore the fox should not be too hasty in his moves.

THE GAME OF QUOTATIONS.

his pleasant pastime is calculated those advanced beyond the age of ɘ childhood; it was suggested by rty of friends, to beguile the tedium long voyage, to those of the passers who disliked spending their ings in whist and piquet.

originated in a discussion on the ɘct of quotations. One of the party, king of the knowledge of the Bible ›ossessed, observed, that she did not think any quotation could be made for which she could not give, at least, the book, and probably the chapter. A gentleman doubted this extent of acquaintance with the Scriptures, and ashed her if she could tell him where the words were to be found—"Is there any taste in the white of an egg?" It was only when she actually saw the text in the Bible she could believe it was really a part of the Book of Job. One of the friends observed that many people were in the habit of quoting without knowing the author, and it would be a curious investigation to ascertain how many of the most common quotations would be ascribed by that company to wrong authors.

Finally the game was organised, and was played thus:—The company being seated together, drew lots for the privilege of first speaking. The person on whom the lot fell was to give some quotation—the more generally in use the better—and whoever first guessed it, and could support his opinion by giving the context, was to have the second text: and so on. It was held that in cases of dispute, the author himself only should be the umpire, so that the work must be produced to decide any question. The forfeit for inability to give the author's name was of a character corresponding with the amusement itself. The defaulters were either to sing, or recite a piece (prose or poetry), according to their ability. For inability to furnish a quotation in turn, the penalty of learning by heart some short piece was exacted. This was to be done before the next meeting of the society.

In the interim, also, disputed points were to be solved, and every one was to be prepared for taking his share in the game.

It was agreed that, as from the varied mental calibre of the friends some would otherwise almost monopolise the replies, and consequently the less gifted would lose their interest in the game, each quotation proffered by one should be given for solution to each individually, according as they sat round the table,

SHADOW BUFF.

Hang a sheet across one end of the room, and place a table with a lighted candle upon it about a yard behind the screen. Choose "buff" from the party, and place him in front of the screen, with his face towards it; then let each of the party pass between the table and the screen in any way they please, such as on tip-toe, or on their knees; and, as the shadow of each will be disguised by their gesture, "buff" must endeavour to name each person as they pass behind the screen; and, if he is successful, the person first named correctly becomes "buff," and the game commences again.

BUFF WITH THE WAND.

The several players join hands, and form a circle around Buff, who stands in the middle blindfold, and bearing a long wand or stick. The players then sing some chorus, and dance once round, when they stop, and Buff stretches out his wand, which the person touched must take by the end. Buff then cries out three times, and the player caught answers in a counterfeit voice, but if Buff guesses his name rightly, they change places. Should, however, Buff guess wrong, the wand is released, and he continues to guess until he names some one correctly. Sometimes Buff pays a forfeit on each failure, as does each player on being caught and named.

SCIENTIFIC RECREATIONS.

MAGIC LANTERN AND DISSOLVING VIEWS.

The principle of its construction is very simple. It consists of a tin box, with a bent funnel at the top, which serves for the double purpose of allowing the smoke and heat to escape, and preventing the light dispersing in the room, and thus interfering with the reflected image. It has a door at the side, a polished tin concave reflector at the back of the inside, and a powerful light placed in the focus of the reflector; the light being supplied by an Argand, oil, or gas lamp, or by the combustion of oxygen and hydrogen gases thrown upon lime. For private exhibitions, the oil Argand-lamp is generally and more easily employed. Opposite to the light and focus of the reflector, is a moveable or telescopic tube, containing a hemispherical illuminating lens near to the reflector, and a convex lens at the extremity of the tube; and between the two lenses is a slit for the introduction of the painted glass slides. The general form of the magic-lantern is shown in figure 7, which represents two lanterns B and L, arranged for exhibiting the dissolving views.

To Use the Magic-Lantern.—Light the lamp, polish the reflector with a dry cloth, and also carefully wipe the lenses to remove any moisture; then place the lamp in the focus of the reflector, close the door of the lantern, and place it upon a table ready for use. Suspend a wet sheet from a line stretched across the room, or have a screen made of calico, stretched tightly upon a frame; in the event of not using either of them, you must reflect the images upon a smooth white-washed wall. Slip in a slide with the figures, and other subjects, inverted or upside down; then advance or recede with the lantern, and by moving the tube in front of the slide, you will be enabled to adjust the focus, and obtain a magnified image of the painting upon the slide, reflected upon the screen, sheet, or wall. When the room is large enough, it is better to place the screen between the spectators and the lantern, as it renders the deception more complete.

The Magic-Lantern Slides may be formed of long strips of glass, cut of sufficient width to pass freely in and out of the slit in the tube of the lantern; and if the designs are not valuable, the edges of the slides may be simply bordered with paper to prevent them injuring the tube.

Fig. 1.

If, on the contrary, the paintings are good, and worth preserving, the glass should be placed in a wooden frame, similar to that shown in the above figure, each slide being numbered or labelled, and the painted surface protected by another slip of glass placed over it, and fixed in the frame.

The most amusing objects for the slides are grotesque figures; sudden transformations, such as a cabbage turning into a tailor, or a basket of eggs into a nest of birds; and moving figures and objects, such as a cobbler at work, a tight-rope dancer, a storm coming on at sea, in which the ship appears to be struck by lightning and consumed, the eruption of Vesuvius, or a railroad with the train passing along. The movements of the figures and objects are obtained by painting the subject upon two glasses, which are fixed in the same frame, and so arranged that when one is drawn aside, or moved upwards or downwards, the first design is concealed, or else another one is added to it.

Sometimes several figures are contained in the same slide, and when the subjects are distinct, such as objects of natural history, or small interior views, &c., the slide is made of mahogany or

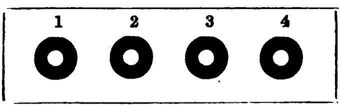


Fig. 2.

deal, with circular pieces cut out in such a manner as to leave a rabbet on one side; the paintings, protected by a plain piece of glass, are then dropped into the holes, and confined by small brads or a thin piece of wood turned to fit in the hole, and each painting numbered or labelled, so as to prevent mistakes, and for the convenience of reference.

To Paint Magic-Lantern Slides.—Provide a small muller, and a piece of thick ground glass five or six inches square to grind the colours on, and a few small bottles to put the colours in. For red get a drop of scarlet lake, blue take Prussian blue, yellow take gamboge, green take a piece of distilled verdigris, and grind it with a quarter of its bulk of gamboge; brown, burnt umber and burnt sienna, black take lamp-black. These are the only colours that are transparent and fit for painting slides. Having all your colours, grind them in balsam of Canada mixed with half its bulk of turpentine, or a little more if too thick for grinding easily, or use mastic varnish, which will get hard sooner than the other, as it will take six or seven days to harden, but the balsam is more beautiful. To paint the glass black round the painting, dissolve asphaltum in turpentine mixed with lamp-black. Having ground all your colours, put them in separate bottles. When used, take out a little with a piece of stick on a piece of glass—not more than you want, as it dries very soon. If too thick, dilute it with turpentine. To paint the slides you must design your subject on paper, place it under the glass, and paint upon the glass according to the design beneath. The brushes to be used are common hair pencils, which may be cleaned from time to time with turpentine.

Dissolving Views.—We have already seen that when a magic-lantern is used, that a view painted upon the slide employed, may be produced in a magnified form upon a screen, sheet, or wall. Now, if we employ two lanterns instead of one, it necessary follows that we shall have two views distinctly thrown upon the screen. Practice will soon enable you to observe, that by altering the focus of the lens after the clear image has been reflected upon the screen, the view becomes dim, and gradually *dissolves* if the focus is still further altered. If the lens of the second lantern, which is supplied with another view, is gradually brought up to the proper focus, the first view may then be said to have dissolved, and assumed the form of the second. The second view then dissolves, and a third takes its place, and so on. The chief object being to show a view which is made to fade gradually, and blend with a second view, which then becomes clear and bright, and fades, in its turn, to blend with a third.

The Dissolving Process may be effected in several ways. 1st. By altering the focus—a plan that succeeds for exhibitions on a small scale. 2nd. By placing the hand gradually over the nozzle of the lantern, and thus obscuring the view by degrees, while a second slide is introduced, and by gradually withdrawing the hand from before the nozzle, the second view is seen developing itself slowly and perfectly. These two plans are applicable for either single or double small lanterns. The best method of dissolving is undoubtedly that employed in all large apparatus; viz., by means of dissolvers or fans, which may be shaped like the one (F) in Fig. 4, (D) in Fig. 7, or else like the one in the margin.

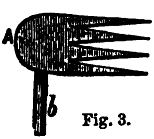


Fig. 3.

The first kind will be explained when describing the apparatus required for the oxy-hydrogen lanterns; the last are simply two pieces of card-board or tin mounted upon metal stems (*b*), which are fixed in a piece of wood at such a distance from each other, and with the part A turned to the outside, so that the one fan obscures the light of one lantern, while the light of the other is displayed. By pulling or pushing the wood in which the fans are fixed, before the nozzles of the lanterns, the views will be dissolved easily and gradually in such a manner, that one view will merge into another so slowly, that the change will appear almost supernatural, producing an effect peculiarly beautiful and attractive.

We have had three diagrams engraved of the apparatus necessary for producing dissolving views on a large scale suitable for a lecture-room or exhibition of any kind.

Our first figure (Fig. 4) represents the form of lantern used at the Royal Polytechnic Institution, London. It

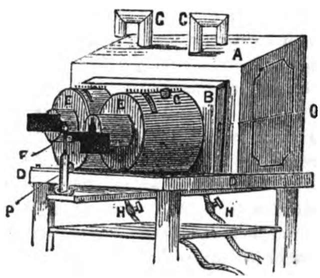


Fig. 4.

consists of a box (A) with a projecting part (B), having an opening (*o*) between the back part and the condensers of the two lanterns contained in the box. The painted slides are inserted at (*o*), and thus pass between the light and the condensers or lenses. In this apparatus, the lenses are made of the best glass, so as to avoid achromatic refraction. The top of the box is fitted with two chimneys (G G) made of japanned iron, to allow the smoke and heat to escape. In front of the box we observe the barrels of the lanterns (E E), with the rack work which regulates the focus by means of a screw (*c*) placed above them. The box containing the two lanterns is placed upon a firm stand (D D)having a slide passing underneath, which is fitted at one end with an upright piece having the dissolving fans placed on either side of a central point (F). By this arrangement the fans can be raised or depressed at the will of the exhibitor, and retained in their position by means of the screw (H), and they may also be made to advance or recede from the nozzles of the lanterns by means of the slide which passes under the table.

In shutting off the light it is necessary to pay attention to the following observations:—When the light is thrown from one lantern, we obtain a large circle or disc of light thrown upon the screen; and our object in exhibiting is always to have a disk of this size, or nearly so, reflected upon the screen; therefore, in shutting off the light, it will be necessary to adjust the fans so that the under part of one lens is only obscured as much as the upper part of the other is displayed. By this means we are enabled to preserve the brilliancy of the views, and prevent the disc being irregular and dusky at the upper and lower parts. As it is sometimes necessary to use both lanterns at the same time, the fans or dissolvers are moveable.

The light used in these lanterns is supplied by the combustion of oxygen and hydrogen gases in a combined state, the flame being thrown upon a cylinder of lime, so as to produce the Drummond Light; and in order that the manner in which this is done may be perfectly understood, we have had a diagram engraved. It represents the interior of the box and the back part of the condensers (B B). About 8 inches from the condensers are cylinders of lime placed upon a pivot which has a small cog-wheel at the lower part of it, and which is connected with another wheel at the lower part of the key (K), used to wind up the machinery. The object of employing this machinery, is to cause the lime cylinders to revolve slowly upon

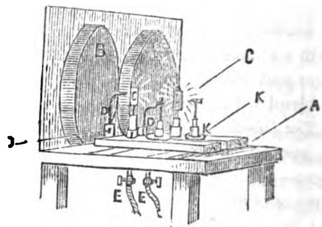
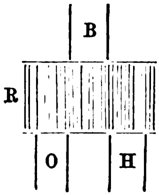


Fig. 5.

their axes, so as to expose a fresh surface to the action of the flame, which is so intense that it will even melt a diamond. Close to the lime cylinders you will see the blow-pipes, by which the gases are thrown upon the lime; these issue from the receivers (D D), where the gases are mixed after being supplied by the pipes (E E) connected with large caoutchouc bags (Fig. 7, F,) placed between press-boards, which are loaded with weights to force the gas out of the bags. After the gases have been mixed, they may be safely ignited at the end of the blow-pipe, and the flame allowed to play upon the cylinder; but you should be careful not to allow a flame to approach these gases in a mixed state, without they are connected with a receiver or a Hemming's safety tube; for if this precaution is neglected, a very dangerous explosion will ensue. It is the method now generally employed to prevent accidents of this kind, and one that is extremely simple and valuable. A square receiver of brass (R) is filled with fine brass wire, which is pressed tightly together, so that when the gases enter the receiver by the tubes (O and H), which are connected



with the caoutchouc bags containing the oxygen and hydrogen gases, they then pass through the spaces between the brass wires, which are now, in fact, narrow tubes. After the gases have been mixed, they pass out of the receiver and through the blow-pipe (B), to be thrown upon the lime cylinder and thus produce a most intense, pure, and beautiful light, well-known as the Drummond Light.

The lime cylinders should be wrapt up in paper singly, and the whole kept in bottles with remarkably well-greased stoppers.

To make the lime cylinders, procure a piece of chalk or limestone, and cut it into pieces about 1½ inch long, and ¾ inch in diameter, and as round as you can; then drill a hole through the centre of each, in the long axis, and having placed them in a crucible in the centre of a good fire, keep them red hot for about four hours. Cool them gradually, and wrap them in paper as soon as possible.

A convenient form of dissolving apparatus for a private exhibition, and also for lecturers who have to travel from town to town, is that shown in Fig. 7. It consists of a stand (A) with folding tripod legs (E,E,E,E), and having a slide underneath, and, as in the former one, supplied with dissolvers, or fans (D). The lanterns (B L) are made of mahogany with japanned iron tops, having a place (S) for the reception of the slides, before which are the moveable tubes (C) with the necessary lenses. A caoutchouc bag (F) fitted with a stop-cock, and flexible or vulcanized India-rubber tube (O) unions, and press-boards, is filled with oxygen gas, the boards are loaded with weights (W) to maintain an

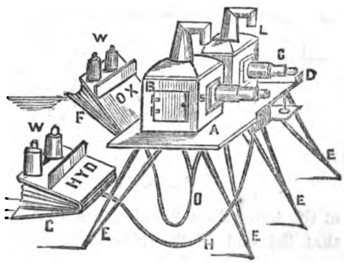


Fig. 7.

equal pressure of the gas, and another similar bag (G) filled with hydrogen gas is also loaded with weights, and connected with the apparatus by a flexible tube (H). This apparatus is so constructed that it may be packed away with the tubes, pressure-boards, lanterns, slides, &c., into a comparatively small space, and as it may be exhibited with as much ease as an ordinary lantern, it is extremely useful for the general purposes of schools, lecturers, and families.

The small magic-lanterns may be procured of almost any optician, and vary in price from 5*s.* to £5. The apparatus shown in Fig. 4 would cost about £120, and that in Fig. 7, from £42 to £100, including all the necessary tubes, gas-bags, apparatus for generating the gases, &c.; but exclusive of slides in every case. The slides vary in price from 1*s.* to 30*s.* each, according to the size, design, mechanical arrangement, and style.

THE PREPARATION OF OXYGEN AND HYDROGEN GASES.

TO MAKE OXYGEN GAS.

Have an iron vessel made of the same shape as (*a b*), in fig. 8; and have a hole

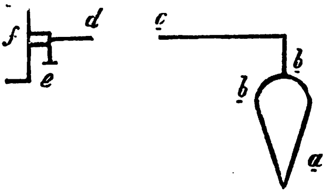


Fig. 8.

at the top, with a female screw in it, so that the end of the pipe (*c b*), which terminates in a male screw, may be fitted tightly to it. The pipe (*c b*) is generally formed of a piece of gas-pipe, and to the end (*c*) is attached a piece of vulcanized India-rubber tubing of the required length, the other end of the tubing being fastened to the nozzle (*d*) of the stop-cock (*e*), which is attached to the caoutchouc gas-bag, which is between the press-boards, marked O X Y in fig. 7. As all the apparatus for making the oxygen is now complete, we will commence by making a good large fire in the grate of the lecture-room or any other room, and while it is burning up, we will unscrew the bent pipe (*c b*) from the retort, and pour an ounce of the salt called chlorate of potash through the hole where the tube was fixed. The tube must now be screwed again, and if it does not fit *very* tight, the outside of the joint as well as the male screw should be *smeared* with a little white lead. A hole must now be made in the centre of the fire, so that the retort may be well covered; and as the form of this retort is the best for generating the gas quickly, be sure to have the press-boards *off* the caoutchouc-bag, the stop-cock turned to admit the gas into the bag, the vulcanized India-rubber tube attached to (*d*) and ready to attach to (*c*); when the gas begins to issue from the end of the bent tube, do not immediately attach the elastic tubing, but allow the first portions of the gas to escape, because it is mixed with the atmospheric air contained in the retort and tube. Make haste now and attach the tubing to (*c*), as the pure oxygen is being rapidly given off from the chlorate of potash. You were just in time: see how the gas-bag is filling; but it will not be quite full, because it holds two gallons—and an ounce of chlorate of potash only gives off 543 cubic inches of pure oxygen gas, which is more than 1½ gallons. This is an important fact to remember, because you may always calculate the quantity of salt required when you know the number of cubic inches the gas-bag holds. All the gas has now passed over, and you must turn the stop-cock (*e*) to prevent its escape from the caoutchouc-bag (*f*), and to remove the tubing from the gas-pipe attached to the retort.

There is another method of collecting and storing large quantities of gases, which is generally employed by the chemist, and which is also very handy for lecturing—we mean Pepy's gas-holder, a section of which is shown in the following figure. It is made of copper, or tinned iron, and may be of any size from four to forty gallons, or more. It consists of a cylinder (*g*) with a shallow pan of the same metal, supported above it by several props, two of which are tubes with stop-cocks (*a b*). Near the bottom is a large orifice (*o*), for receiving the gas. To use this instrument, it is first filled with water by closing the lower orifice (*o*) with a large cork, and opening all the upper ones (*a b s*). Water is then poured into the shallow pan (*p*) until it runs out at *s*, which is then closed, and the remainder

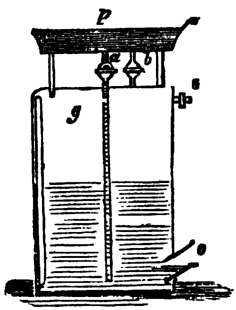


Fig. 9.

of the air escapes through *b*; when it is full, the cocks (*a b*) are shut; and the lower orifice being then opened, the water, sustained by the pressure of the air, cannot escape except as it is driven out by the entrance of the gas at (*o*), from which the water escapes as fast as the gas enters. When used, the gas-holder must stand over a tub, to catch the water which is driven out at (*o*) The gas is obtained for use by drawing it off from the orifice (*s*), to which the vulcanized India-rubber (*h*, fig 7.) is attached, that is connected with the chamber of the blowpipe in the dissolving view apparatus. In order to draw off the gas from the cylinder, the cock (*a*) must be open and the pan (*p*) full of water; the tube to which the cock is attached goes nearly to the bottom of the gas-holder, and the pressure of the water in the pan forces out the gas through the orifice (*s*).

TO MAKE HYDROGEN GAS.

Procure a large wide-mouthed bottle, and fit a cork to it, then with a hot iron bore two holes in the cork, one to receive the tube-funnel through which the diluted sulphuric acid or oil of vitriol (one part of acid to five parts of water) is poured into the bottle, and the other to receive the bent tube which delivers the gas as it is generated. Place some granulated zinc or zinc cuttings in the bottle, pour the diluted acid through the tube-funnel, and you will soon see an effervesence take place and the hydrogen gas escape from the mouth of the bent-tube; while the first portions of the gas are escaping, we will prepare the caoutchouc-bag marked H Y D, fig. 7, by removing the upper press-boards and weights, turning the stop-cock and attaching the vulcanized India-rubber tubing. As the gas that is now issuing from the tube is not mixed with atmospheric air, we may *safely* collect it in the gas-bag; but had we done so at first, an explosion would have taken place as soon as a light was applied to the impure gas. You see that the gas-bag is filling rapidly, and as soon as it is full we must proceed as we did after the oxygen was procured.

THE PHANTASMAGORIA

Is exhibited in the same manner as a magic lantern, but a prepared screen is placed between the spectators and the exhibitor, and instead of a circle of light being thrown upon the screen, only the figures are observed. The peculiar effect is obtained by painting a figure upon a slide and filling in the surrounding parts with black paint, and also by having the lantern mounted upon a framework or table furnished with wheels, so that the operator may be able to make the figures appear to advance and become large, or recede and diminish by altering the position of the table or framework, and the focus.

The Phantasmagoria Screen is generally made of thin muslin, which has been coated with virgin wax dissolved in turpentine, but sometimes it is only coated with thin spirit varnish. In the former case it may be rolled up without injury, but in the latter case it requires to be kept stretched upon a frame, and is very liable to crack.

CHROMATROPES

Form a most pleasing exhibition, and they are always hailed with delight.

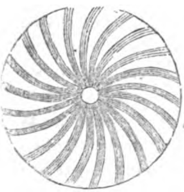


Fig. 10.

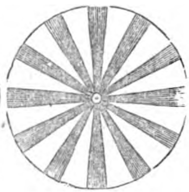


Fig. 11.

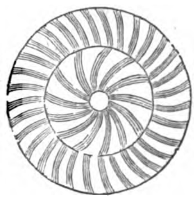


Fig. 12.

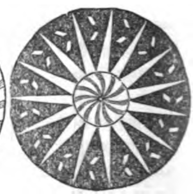


Fig. 13.

To Paint the Chromatropes, proceed in the same manner as if you were doing magic lantern slides, only each chromatrope requires to have *two circular* pieces of glass fitted in a frame and painted with some device, such as figs. 10, 11, 12, and 13. Any design constructed upon the same principle, will answer well.

Fig. 14.

As a guide to the general colouring required, we think it advisable to describe Figs. 10 to 13 inclusive. Fig. 10 is painted with alternate crimson and bright yellow spirals; Fig. 11, alternate blue and red sections; Fig. 12, is painted with red spiral lines for the inner circle, and alternate yellow and blue for the outer circle; and Fig. 13, has alternate yellow and red spirals for the inner circle, and the top row of rhomboids are crimson, and the lower row cobalt blue. All these form very pleasing designs when nicely executed.

TO MAKE A CHROMATROPE SLIDE.

Have a piece of wood constructed the same as Fig. 14, the grooves between the pieces of wood being for the string or catgut, which is attached to the wheels at either end, to work in. The large wheels must contain the chromatrope designs, each being alike but reversed, so that when they are moved in contrary directions by means of the simple mechanical contrivance about to be described, the designs exhibited upon the screen are both surprising and beautiful. Each wheel has a groove at its edge, in which a piece of catgut or string runs freely and passes along the grooves in the slides, the string attached to the upper wheel passing along as far as the upper groove in the wheel, and the string belonging to the under wheel passes along the outer grooves to the under groove in the lesser wheel, which is screwed tight in its place by a nut underneath, so that when the large wheels are required to be changed, the nut is unscrewed and the wheel pushed towards the larger one, in order to slacken the strings; this is accomplished by making the pinion slide along a notch in the frame, thus:

Now when the handle of the lesser wheel (Fig. 14) is turned, the two large wheels revolve in contrary directions, and cause a very pleasing appearance upon the screen.

The chromatropes are exhibited precisely in the same manner as a magic lantern slide; in fact this kind of slide takes its place, and may be dissolved precisely in the same manner.

MAGIC DANCES.

This is a most amusing recreation, and has astonished people almost as much as the phantasmagoria. It is founded upon the principle that the shadow of an object becomes multiplied as we multiply the number of lights. The manner of proceeding is very simple:

Make a screen of tissue-paper very neatly gummed at the edges, or use a phantasmagoria screen; but, in either case, the medium or screen must be large enough to reach across the room, and the edges should be concealed by a curtain, or something else, so as to prevent the spectators peeping behind it; about two feet behind the medium construct the magic curtain, which should be fixed in the open space of a doorway, as shown in the following figure:

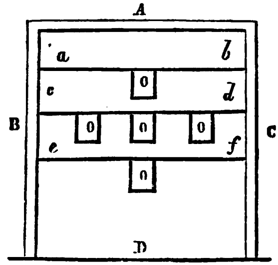


Fig. 15.

To the slides of the doorway A B C and the floor D, fix the magic curtain—which should be made of canvass painted black on both sides, or thick brown paper, or grocer's thick blue paper pasted upon an old sheet,—fasten the battens *a*, *b*, *c*, *d*, *e*, *f*, between the door-posts, each batten being about 1½ inch in width; then cut out five or more holes (*o o o o o*) in the magic curtain, immediately under the battens, as in Fig. 15. Each of these holes is to be provided with a flap of millboard which is attached to the magic curtain by a hinge below, as shown in Fig. 16, where the upper hole (*o*) is seen closed, the middle hole has the flap (*p*) partially lowered, and the lower hole has the flap hanging quite down, the same as when the figures are being exhibited. It is necessary to have these flaps about two inches wider than the holes, so as to exclude the light behind, and when the holes, which vary in size, according to the room, are closed, the flaps are

fastened up by a button of this shape; fastened to the button above, the button being placed at the side of the hole, not in the centre. The next things you have to prepare are the magic lights, and the sticks to hold them.

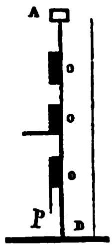


Fig. 16.

To make the magic lights, procure two coiled wax tapers, untwist them, and cut each taper into six equal parts; place a piece of cotton wick in the centre of the six pieces of taper, and twist them well together so as to make them firm. Cut the seven-wick taper into pieces about three inches long, trim the wicks and moisten them with turpentine.

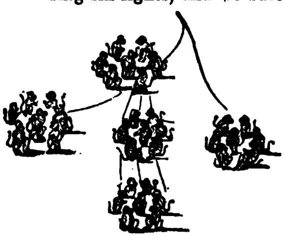
To prepare the sticks, get a piece of deal batten an inch wide, cut it into pieces three feet long, and nail these to a handle. To each arm of these sticks fasten a piece of tin coiled round to receive the candles, or drive nails through the ends and stick the tapers upon them.

It now only remains to make the figures; we shall then be able to exhibit.

The magic figures may represent monkeys or dogs, dancing round a man playing the violin; witches dancing round their cauldron, which is boiling over a fire in the centre; fairies, or anything that fancy may suggest. Each figure is painted upon glass, in the same manner as a magic lantern slide, then framed and hung up to a nail placed in the button, in the centre of each hole; therefore if we have five holes in the magic curtain we shall want four dogs or monkeys, and one man playing the violin; four witches and one cauldron, &c. Sometimes the magic figures are merely cut out of cardboard and fastened in the holes of the magic curtain by means of pins, but in any case the cauldron or man must occupy the centre holes, and the other figures be arranged behind the remaining holes. Of course any increase in the number of apertures in the magic curtain will require an increase in the number of figures, and *vice versa*.

To exhibit the dances procure some person to assist you, and arrange certain signals before commencing: for example, when you point with your finger to the left, he must move in that direction; if you point to the curtain, the lights must be advanced; if over your shoulder, he must recede, and so on. At a given signal, let all the lights be extinguished in the room where the spectators are assembled. Light four tapers, not mounted upon sticks, and hold them all together in your hand; and then lower the centre flap of the curtain; and immediately this is done, a boiling cauldron will be seen upon the transparent screen; lower another flap, and then a witch will appear suddenly. Now give your assistants two of the wax tapers, and there will be two witches and two cauldrons; then take a candle in each hand, and direct your assistant to do the same, and there will be four witches and four cauldrons; move to the right or left, and the figures will move; raise, and depress the lights, advance and recede; then reverse your operations and there will only be one cauldron and one witch. Now get one of the sticks with three candles, and light them successively. As you do this, the witches will re-appear; give your assistant two tapers together, and as there will be five lights burning, there will be five witches and five cauldrons; advance, and open another flap, and then another until they are all open; then blow out your lights one by one until only one remains; and let your assistant then close up all the flaps one after the other, the cauldron being the last. Let the lights in the room, where the spectators are, be replaced, and you can then change the figures for some monkeys. Proceed the same as with the witches, and you will astonish the people with the sudden change and the grotesque movements of the animals, particularly when you have five figures of them shown upon the screen, as in the following figure:

When you have produced this effect, turn yourself round, but not too suddenly, and the monkeys will trot round; then move the light about, and turn round suddenly. Now light another stick holding six lights, and be sure to



extinguish the lights you have, as the others are ignited. Proceed as before, and thus by replacing the figures with others, and varying your movements, much amusement may be afforded.

A CURIOUS RECREATION WITH SYMPATHETIC INK.

(Called the Book of Fate.)

Make a book, consisting of seventy or eighty leaves, and in the cover at the end of it, let there be a case which opens next to the back, that it may not be perceived. At the top of each right-hand page, write any question you please, and at the beginning of the book, let there be a table of those questions, with the numbers of the pages in which each are to be found. Then write with common ink on separate papers, each about half the size of the pages, the same questions that are in the book; and under each of them write, with the ink made with the litharge of lead, or the solution of bismuth, the answer. Soak a double paper in a vivifying ink, made of quick-lime and orpiment, or the liver of sulphur, and just before you make the experiment, place it in the case, that is in the cover of the book. Having done this deliver some of the papers on which the questions are written, to the company; and after they have chosen such as they wish to have answered, let them put them into those leaves where the same questions are contained; then shutting the book for a few minutes, the sulphureous spirit, with which the paper in the cover of the book is impregnated, will penetrate the leaves, and make the answer visible, which will be of a brown colour, and more or less deep, in proportion to the time the book has been closed.

Before trying this scientific recreation in company, boys should make careful experiments, to be sure that they can neatly accomplish it. Be sure, too, that every particular of our instructions is strictly adhered to.

INTERESTING TRICKS OF LEGERDEMAIN.

TO CUT AND TEAR IN PIECES A HANDKERCHIEF, AND TO RENDER IT WHOLE AGAIN.

Two persons of the company are desired to step forward; a handkerchief is given to hold, two corners each. Several other handkerchiefs are then procured from the company, and as they are received, they are put into the one that is held, in order to make them a bundle. When there are about a dozen of them heaped up together, the two persons who hold the bundle cause one of them to be drawn at random by a third spectator. The person who draws it is then desired to examine its mark and number, if any such there be, and to cut off one of the corners with a pair of scissors; any one may cut a piece also, after that the handkerchief is torn in pieces. The bits and scraps being gathered together, on which are poured certain pretended drugs or liquors, all are folded, and firmly bound with a ribbon, in order to reduce them to a small parcel. They are then put under a glass. A few minutes after, the parcel is unfolded, the handkerchief is whole; everybody acknowledges the mark, and the spectators are surprised to see it has not received the least damage in the operation.

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

TO TAKE A SHILLING OUT OF A HANDKERCHIEF.

You ask one of the company for a shilling; then you take a handkerchief, and twist a corner of it round the shilling; the form of the piece of money will appear; but in order to convince the company that it is the shilling, you take it out and show it to them again. You then exhibit the form of the shilling, as before, in the handkerchief, and desire one of the company to hold it fast. You even make it sound to convince them that the shilling is in it. While the person is holding the handkerchief, you tell him that he will find the shilling in his hat, which he had laid down. You take the handkerchief from him while he goes to look at hat, and he there finds the shilling.

Explanation.—You must have a curtain ring about the size of a shilling. At first you put the shilling into the handkerchief: but when you take it out again to convince the company there is ***no deception***, you slip the curtain ring in its stead; and while the person is eagerly holding the handkerchief, and the company's eyes are fixed upon the form of the shilling, you seize this opportunity of putting it into a hat or elsewhere. When you get possession of the handkerchief again you slip away the curtain ring.

TO MAKE A BALL CHANGE COLOURS.

You open a box, and show the company a ball of ivory, which fits into it; then you put the ball into the box, and the cover on. You then take the cover off, and the ball. You put the cover on, and when you show the ball again, it is black, &c.

Explanation.—A box must be made for this purpose, with three or four covers ingeniously wrought, and the inside ones of different colours. After the ball is exhibited by a secret spring, you attach one of the covers to the ball, which renders it of a different colour; in like manner another, and so on till all the secret covers are disposed of. These covers, which serve as shells for the ball, must be manufactured very thin, ingeniously turned, and nicely fitted for the purpose.

HOW TO TAKE THREE BALLS OFF TWO STRINGS.

You show two pieces of strong tape to the company, of an exact size, and then you show the balls which have a hole through the middle of them; having put on one ball yourself, you let the person who is to hold one end put on the second ball, and the person who is to hold the other end the third ball. Each person has two ends which are of the same length. Suddenly you jerk the balls which slip off, while the strings, when examined, remain as before.

Explanation.—While the balls are examined you double each string, and each appears to have two even ends; you twist the double end of each together, and putting on one of the balls, which has a hole smaller than the others, over the place that is joined, the strings remain firm, and can bear to be pulled. Each person that holds it thinks he has the extremities of two strings, while in fact he has only the end of one. By a jerk the middle ball comes off, followed by the rest; you then slip them into the hands of one of the persons who holds the strings; he of course lets go his hold, and you then take care to put the strings lengthways. This is a good trick when well managed, but it requires dexterity to conceal the deception. Formerly this trick was done with three button moulds on two small whipcords of about two feet each, and with three rings on two ribbons, but the balls and tapes are preferable.

TO SHUT UP A PIECE OF MONEY OR A RING IN A BOX FROM WHENCE IT ESCAPES WITHOUT BEING TOUCHED.

You ask one of the company for a piece of money or a ring, which in his presence is deposited in a box. You then give him the box to hold; beg of him to shake it, when the money or ring is consequently heard to rattle within. You then desire him to shake it harder, but on being repeatedly shaken the sound is no longer heard, and the piece of money or ring is found in somebody's hat or pocket.

Explanation.—This box is made so that in shaking it softly up and down it has a rattling sound as if there was money or something else in it. On pretence of showing the person how it should be shaken, you take the box, and though locked, the piece of money or ring drops into your hand, through a little chink which opens secretly. The box will continue to rattle till shaken strongly in a horizontal direction, when a little spring falls upon the sounder, and hinders it from making a noise. It is then imagined that the piece of money or ring is gone, and by means of a sly confederate, who gives a timely hint, you point to the person's hat or pocket where it is.

TO LET A PERSON HOLD A PARTICULAR NUMBER OF COUNTERS OR HALFPENCE IN HIS HAND, AND TO INCREASE THE NUMBER.

You throw a quantity of counters or halfpence on the table, and desire one of the company to reckon ten pieces. He complies. You give him the money to hold, and tell him that any number he thinks of between ten and fifteen he shall have. Accordingly, when he opens his hand, he finds fifteen pieces. You may perform this trick in another manner, and with as many of the company as you please. You desire one person to reckon five pieces which you give him, another six, another seven, and so on, and every person shall have one more.

Explanation.—To perform this trick in the first way, you must have five pieces privately concealed in your right hand. You then tell the person who has reckoned out the ten pieces that you must be sure he has taken only ten, and moving the rest of the counters or halfpence away, you tell them down on the table with your left hand, and taking them up with your right, convey the five pieces to the ten, and thus put fifteen pieces into the person's hand. The other way of performing this trick is by cleverly palming a counter or piece of money, and consequently putting one more into the person's hand than he thinks. You must have secret pieces, and you must divert the company with stories while attaching a piece to the palm of your hand under the table. You take up the pieces, when reckoned, with this hand, by which means you add one to the number.

MULTIPLYING COIN.

Tell the company that you believe you can, by the exercise of your magical powers, increase sixpence to eighteenpence before their eyes. The sixpence having been procured, get a glass of water and a plate; put the sixpence into the tumbler, and then, covering it with the plate, turn it upside down on the table: the coin will seem on the plate, and appear a shilling, while the sixpence will seem to be floating on the top.

TO LIGHT A CANDLE WITH WATER.

Get the smallest piece of phosphorus, and with a little tallow place it on the rim of a tumbler; next get a lighted candle, blow it out, then hold it to the glass, and it will at once ignite.

TO ASTONISH A LARGE PARTY.

With some lycopodium, powder the surface of a large or small vessel of water; you may then challenge anyone to drop a piece of money into the water, and that you will get it with the hand without wetting your skin. The lycopodium adheres to the hand, and prevents its contact with the water. A little shake of the hand, after the feat is over, will dislodge the powder.

HOW TO MAKE EGGS DANCE.

Boil an egg hard, and break off a little piece of the shell at either end; then thrust in a quill filled with quicksilver, and sealed at each end. As long as the egg is warm it will continue to dance.

LUMINOUS WRITING.

Place a small piece of solid phosphorus in a quill, and write with it upon paper. If the writing be then taken to a dark room it will appear beautifully luminous.

THE BALANCED STICK.

Having obtained a piece of wood of eight or nine inches in length, and half an inch in thickness, thrust into the upper end the blades of two penknives on each side. Place the other end on the tip of the forefinger, and it will balance without falling.

THE DOUBLE MEANING.

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

COMIC CARDS.

Get a number of cards of the same size, and draw and colour on them faces (male and female) as grotesque as your humour can invent. Decorate the heads of your pictures with night-caps, old hats and new hats, wigs of all colours, and warriors' helmets. The compass of each face should occupy the same space. Then divide each card into three pieces, cutting it in a straight line just below the eye, and across the upper lip. All the tops and middles should be of the same width, and the bottoms about the same size as the tops. Endless changes may be obtained by placing the forehead of one card in contact with a chin or nose on a second and third card.

THE THREE SPECTRAL WAFERS.

Place three different coloured wafers, say red, violet, and orange, upon a piece of white paper, in a triangular form, and fix your eyes steadily on them for two minutes, and then turn them away from the wafers, to a blank part of the paper, and you will see *three spectral wafers*, but the colours will be different; the red wafer is now represented by green, the violet by yellow, and the orange by blue.

THE CONJUROR'S STROKE.

Take a ball in each hand, and stretch both your hands as far as you can one from the other; then inform the company that you will make both balls come into which hand they please to name. If anyone doubt your ability to perform this feat, you must lay one ball on the table, turn yourself round, and then take it up with the hand which already contains a ball. Thus both the balls will be in one of your hands, without the employment of both of them.

THE OBEDIENT WATCH.

Borrow a watch from a person in company, and request the whole to stand around you. Hold the watch up to the ear of the first in the circle, and command it to go; then demand his testimony to the fact. Remove it to the ear of the next, and enjoin it to stop; make the same request of that person, and so on throughout the entire party. You must take care that the watch is a good one. Conceal in your hand a piece of loadstone, which so soon as you apply it to the watch, will occasion a suspension of the movements, which a subsequent shaking, and withdrawing of the magnet will restore. For the sake of shifting the watch from one hand to the other, apply it when in the right hand to the left ear of the person, and when in the left hand to the right ear.

AN EGG PUT INTO A PHIAL.

To accomplish this seeming incredible act, requires the following preparation: You must take an egg and soak it in strong vinegar; and in process of time its shell will become quite soft, so that it may be extended lengthways without breaking; then insert it into the neck of a small bottle, and by pouring cold water upon it, it will re-assume its former figure and hardness. This is really a complete curiosity, and baffles those who are not in the secret to find out how it is accomplished.

HOAR FROST MADE TO ORDER.

Place a sprig of rosemary or any other garden herb in a glass jar, so that when it is inverted, the stem may be downwards, and the sprig supported by the sides of the jar; then put some benzoic acid upon a piece of hot iron, so that the acid may be sublimed in the form of a thick white vapour. Invert the jar over the iron, and leave the whole untouched until the sprig be covered by the sublimed acid in the form of a beautiful hoar frost.

TO LIFT 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, put this curved end into the bottle, so that the bent part may rest against its side; you may then take the other end, and lift up the bottle by it, without breaking the straw, and this will more easily be accomplished as the angular part of the straw approaches nearer to that which comes out of the bottle.

TO BREAK A STICK UPON TWO GOBLETS.

Place two glasses full of water upon two joint stools, and lay the stick upon them; then strike the stick violently with another, and it will break without either injuring the goblets or spilling the water. This feat requires some practice.

COLUMBUS'S TRICK—THE STANDING EGG.

To make an egg stand on one end on any polished surface seems very extraordinary, yet it can be done, even on a looking-glass. Now, from the form of an egg, nothing is more liable to roll, and on nothing more so than a looking-glass; to accomplish this trick, let the performer take an egg in his hand, and while he keeps talking and staring in the face of his audience, give it two or three hearty shakes; this will break the yolk, which will sink to one end, and consequently make it more heavy, by which when it is settled, you may make it, with a steady hand, stand upon the glass; this would be impossible while it continued in its proper state.

ARTIFICIAL FIRE-BALLS.

Put thirty grains of phosphorus into a bottle which contains three or four ounces of water. Place the vessel over a lamp, and give it a boiling heat. Balls of fire will soon be seen to issue from the water, after the manner of an artificial fire-work, attended with the most beautiful coruscations.

TO MELT STEEL AS EASILY AS LEAD.

Make a piece of steel red in the fire, then hold it with a pair of pincers or tongs; take in the other hand a stick of brimstone, and touch the piece of steel with it. Immediately after their contact, you will see the steel melt and drop like a liquid.

TO TELL A LADY IF SHE IS IN LOVE.

Put into a phial some sulphuric ether, colour it red with alkanet, then saturate the tincture with spermaceti. This preparation is solid ten degrees above freezing point, and melts and boils at twenty degrees. Place the phial which contains it in a lady's hand, and tell her that, if in love, the solid mass will dissolve. In a few minutes the substance will become fluid.

THE MAGIC CUPS.

Procure two tin cups without handles, quite plain, straight sides, with the bottoms sunk a quarter of an inch. On the bottoms spread some glue, and completely cover the glue with some kind of birdseed, only so as not to be seen when standing in an ordinary position. Have ready a bag filled with the same kind of seed as you used in covering the bottoms. Put the cups on the table; also two hats. Put one cup then into the bag, appear to fill it, and take it out turned bottom upwards, when it will look as if it had been filled. Put it in that position under one hat, in doing so turn it over. Then take the other empty cup, put that under the other hat; in doing so, turn that over, which, of course, must be invisible to the audience. Then remove the hat, and the cups will appear to have changed places.

FIRE UPON ICE.

If a piece of potassium be pressed with a penknife upon a cake of ice, the chemical action of the materials is so energetic that they burst into a beautiful reddish-purple flame, and a hole is made in the ice where the potassium came in contact with it.

Another way to make a fire is the following:—Make a hole in a block of ice with a hot poker; pour out the water, and fill up the cavity with spirits of camphor; the spirit may then be set on fire. It will have the singular appearance of "ice in flames."

CARD TRICKS.

TO MAKE THE COURT CARDS ALWAYS COME TOGETHER.

TAKE the pack, and separate all the Kings, Queens, and Jacks; put these all together into any part of the pack you fancy, and inform one of the company that he cannot in twelve cuts disturb their order. The chances are 500 to 1 in your favour; but with a novice the feat becomes impossible. This is a very amusing and easy trick.

This trick may also be rendered more wonderful by placing one-half of the above number of cards at the bottom and the other half at the top of the pack.

"The Queens going to dig for diamonds," is one of the prettiest of these feats by cards. Take all the Queens, Kings, Knaves, and Aces, and four common cards of each suit from the pack. Then putting the four Queens together, lay them down, face upwards, on the table, and say—"These four Queens went out together to dig for diamonds. (Here you place four cards of Diamonds half over them), and each one took a spade (placing four Spades half over the Diamonds;) but the four Kings, their husbands, fearing that they would meet danger on the road, sent an escort after them for a protection (Here you put the Aces half over the Spades); the Kings, however, became anxious, and all set out together after their wives (Here the Kings must be placed half across the Aces); this business getting wind, four robbers determined to lie in wait for the Queens on their return, and seize the diamonds thus procured (place the Knaves half over the Kings); each one of these robbers was armed with a club (Put the Clubs half over the Knaves); and all were well known as the bravest stoutest-hearted men in that country" (Laying the Hearts half over the Clubs), Having finished your cards, you now pack them up into one parcel—that is, you first take up the Queens, and place them, face downwards, upon the table; then keeping the Diamonds together, you lay them in the same way, face downwards, upon the Queens, and so on. Give the cards to anyone who wishes to cut, and afterwards cut them yourself, until the common card of Hearts remains at the bottom: if you lay them out as before, you will find them all come into their proper order.

TO MAKE A CARD JUMP OUT OF THE PACK.

Let any person draw a card, and afterwards put it into the pack, but take care that you know where to find it at pleasure. This you may do by having *forced* it. Then put a piece of wax under the thumb-nail of your right hand, and fasten a hair by it to your thumb, and other end of the hair, by the same means, to the card chosen; spread the pack upon the table, and, making use of any words you think fit, make it jump from the pack about the table.

TO MAKE TWO CARDS COME TOGETHER.

Get somebody to select two cards, which he would desire to have brought together; then, when he has named them, take the pack into your own hands, under the pretence of seeing whether they really are in the pack, excusing still further the answer by remarking, "Now, having found them, I will put them still farther asunder," at the same time dispersing them; but discover the preceding card of one of them, and by keeping the rest back, you may easily cause them to come together.

ARITHMETICAL AND GEOMETRICAL PROBLEMS.

1.

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

2.

There are two rooms, the floors of which contain an equal number of square feet: the one being 50 feet by 30, the other 40 in length. What is the breadth?

3.

How many yards of paper, $\frac{3}{4}$ of a yard wide, will cover a chamber that is 60 feet round, and 10 feet $1\frac{1}{2}$ inches high?

4.

A hare starts 40 yards before a greyhound, and is not perceived by him till she has been up 40 seconds: she gets away at the rate of 10 miles an hour, and the dog pursues her at the rate of 18 miles an hour: how long will the course last, and what distance will the hare have run?

5.

If a person have an annual profit rent of 75*l.*, which is payable yearly, and is to continue 32 years, how much ought he to get for it at present, allowing the purchaser compound interest at 4 per cent. per annum on what he pays for it?

6.

A merry old workman, a thrasher of corn,
Agreed with a farmer, one Anthony Horn,
To thrash wheat by the bushel, ten groats for a score,
And at half-a-crown, barley—the price was no more;
Just one hundred bushels he thrashed to his mind,
And then he received the sum here subjoin'd:*
What he thrash'd of each sort I request you will find?

* 14s. 2d.

7.

Divide the number 50 into two such parts that, if the greater part be divided by 7, and the less multiplied by 3, the sum of the quotient and the product will make 50.

8.

An ornament with ease you'll find,
From what is underneath subjoin'd,
Which greatly doth become the fair,
In every season of the year.

The name of the ornament is composed of three letters in the alphabet: the place of the first letter is three times that of the second; the place of the third is five times that of the first, + 1, and the sum of all the three letters' places is 20.

9.

From January the tenth in a Bissextile year,
To December the eighteenth, pray make it appear,
What the amount of six hundred bright guineas will be,
At four and-a-half per cent.—Tell this to me?

10.

A gamester lost in four turns of dice, 160 shillings, trebling his stake each turn. How much did he play for the first and last time?

11.

Three gentlemen and their servants having to cross a river, find a boat without its owner, which can only carry two persons at a time. In what manner can these six persons transport themselves over by pairs, so that none of the gentlemen shall be left in company with any of the servants, except when his own servant is present?

12.

A Cheshire cheese being put into one of the scales of a false balance, was found to weigh 16lbs., and when put into the other only 9lbs. What is the true weight?

13.

A company at a tavern spent 6s. ¼d., and each of them had as many farthings to pay as there were persons in company. How many persons were there?

14.

A woman carrying eggs to market was asked how many she had. She replied, that when she counted them by 2's, there was one left; when by 3's, there was one left; and when by 4's, there was one left; but when she counted them by 5's, there were none left. How many had she?

15.

A poor woman, carrying a basket of apples, was met by three boys, the first of whom bought half of what she had, and then gave her back 10; the second boy bought a third of what remained, and gave her back 2; and the third bought half of what she had now left, and returned her 1; after which she found she had 12 apples remaining. What number had she at first?

16.

A market-woman bought 120 apples at two a-penny, and 120 more of another sort, at three a-penny, but not liking her bargain, she mixed them together, and sold them out again at five for two-pence, thinking she should get the same sum; but on counting her money, she found to her surprise that she had lost 4d. How did this happen?

17.

The three Graces, carrying each an equal number of oranges, were met by the nine Muses, who asked for some of them; and each Grace having given to each Muse the same number, it was then found that they had all equal shares. How many had the Graces at first?

18.

It is required to name the quotient of five or three lines of figures (each line consisting of five or more figures) only seeing the first line, before the other lines are even put down. Any person may write down the first line of figures for you. How do you find the quotient?

19.

An old man married a young woman; their united ages amounted to 100. The man's age multiplied by 4 and divided by 9, gives the woman's age. What were their respective ages?

20.

A has bushels of wheat worth 4s. each, but in barter will have 5s., and 1-5th of barter-price in ready-money. B has a horse worth 12*l.* to exchange with A for his wheat, but will have 1-3rd of the barter-price of the horse in ready cash. Required, the barter-price of the horse, and the number of bushels of wheat B must give A to make the barter equal.

21.

A man coming from the Lochrin distillery with an 8-pint jar full of spirits, was met by a person going thither with a 3-pint jar, and one of

5-pints, both empty. Being pressed for time, he begged the person who was returning to give him four pints out of his quantity. How are they to measure 4 pints exactly, with these three jars only?

22.

The sum of four figures in value will be,
Above seven thousand nine hundred and three;
But when they are halved, you'll find very fair
The sum will be nothing, in truth I declare.

23.

The moon it shone bright, yet long was the road,
My horses were weary, and heavy their load;
To pass the dull hours, and enliven the way,
To a friend by my side, I did mirthfully say:
"Come number to me, as we travel the ground—
My wheel is a circle *twelve feet* in the round;
Twelve miles is the distance—now pray can you tell,
From the black pits of Tindal that stand on the Fell,
How often that wheel round its axis will roam,
Till Armathwaite Bridge bids us welcome to home?"
To be solved by reduction.

24.

This following simple question is at first puzzling:—A snail wants to get up a wall 20 feet in height, during the day it climbs 5 feet, but slips back 4 feet every night; how long would it take to reach the top?

25.

If a person's yearly income be 1,000*l.*, what was the difference between his daily income in the years 1847 and 1848

26.

Put four fives in such a manner, that they shall make 6½?

27.

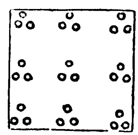
A person writing down a line of figures at pleasure, and another person striking out one, to tell the figure struck out?

28.

When the height of the mercury in Fahrenheit's is equal to one fourth of the cube of its height in Reaumur's thermometer, it is required to find the degree of temperature which these instruments respectively indicate?

29.

Twenty-four nuns were arranged in a convent by night, by a sister, to count *nine* each way, as in the diagram. *Four* of them went out; how were the remainder placed in the square, still to count nine each way? The *four* that went out returned, bringing with them *four* friends; how were they all placed still to count *nine* each way? *Four other* friends obtained admittance; they were still placed so as to count *nine* each way, and thus to deceive the sister, whether there were 24, 20, 28, or 32, in the square. How was this accomplished?



30.

How many steps would a gardener have to take who had to water 100 trees, distant five steps from each other, and who is obliged to fetch the water for each tree from a well, distant ten paces from the first?

31.

A person wishes by saving 6d. one week, 6½. the next week, 7d. the third, and so on, to accumulate the sum of 104*l*. 11s. How long will it be before he has attained his object?

32.

A gentleman dying left his executor a sum less than 2,000*l*., to be divided between his relations in such a manner that his father and mother, son and grandson, brother and daughter, should receive a sum not less than 666*l*. 13s. 3d. Required the relationship, and the sum to be divided?

33.

If from six you take nine, and from nine
you take ten,
(You youths now the mystery explain);
And f fifty from orty be taken, there
then
Shall just half a dozen remain.

34.

Supposing there are more persons in the world than any of them has hairs upon his head, it then necessarily follows that some two of them at least must have exactly the same number of hairs on their heads to a hair. Required the proof?

35.

Two-thirds of six, if multiplied
By just one-fifth of seven,
Then what's the number that's descried
When product's fairly given?

36.

Smith walking out, finds, on turning round, that Thompson is 400 yards behind him, desiring to overtake him; they each of them moved 200 yards with their faces towards each other in a direct line, yet were still 400 yards asunder. How could this be?

37.

Come tell to me, what figures three,
When multiplied by four,
Make five exact (it is the fact),
This unto me explore?

38.

It is required to place four 2's in such a manner as to form four numbers in geometrical progression?

39.

Two boys amusing themselves at "snatch-apple," in a room thirteen feet high, find that by standing twelve feet from each other, the apple, which is suspended from the ceiling by a string, and in a right line between them, when put in motion, just touches each of their watery mouths. Required the area of the section described by the string and apple; the perpendicular height of each boys mouth from the ground being five feet?

40.

How many days can five persons be placed in different positions round a table at dinner?

41.

Seven gentlemen travelling met at an inn, and being pleased with each other's company and their host, offered him 50*l* to board them, so long as they could sit every day at dinner with him in a different order, to which he readily consented. How long would they be entitled to stay?

SOLUTIONS TO ARITHMETICAL AND GEOMETRICAL PROBLEMS.

1.

$99\frac{8}{9}$.

2.

37 feet 6 inches.

3.

90 yards.

4.

Time of course, $60\frac{5}{22}$ sec. Distance the hare ran 490 yards.

5.

There $a=104$, the 32nd power of which is 3,508059. Dividing 1 by this, we get 0·285058; the difference between which and 1, is 0·714942: and by dividing this 0·04, we obtain 17·87355, which is the present value of 1*l*. of the annuity. Multiplying it by 75, we get 1,340*l*. 10s. 4d., the required price.

6.

40 bushels of wheat, and 60 of barley.

7.

35 and 15.

8.

Cap.

9.

656*l*. 12s. $9\frac{1}{2}$d.

10.

4s. and 108s.

11.

First, two servants must pass over; then one of them must bring back the boat, and repass with the third servant; then one of the three servants must bring back the boat, and stay with his master, whilst the other two gentlemen pass over to their servants; then one of these gentlemen with his servant must bring back the boat, and, the servant remaining, his master must take over the remaining gentleman. Lastly, the servant who is found with the three gentlemen, must return with the boat, and at twice take over the other two servants.

12.

The true weight is a mean proportional between the two false ones, and is found by extracting the square root of their product. Thus $16 \times 9 = 144$; and square root $144 = 12$lbs., the weight required.

13.

First 6s. $\frac{1}{4}$d. $=289$ farthings; and this must be equal to the number of persons multiplied into the sum spent by each. In the present case, the multiplicand and the multiplier are equal, and therefore we have only to find what number multiplied into itself will produce the given sum, 289; this $=17$, the number of persons. Whence 17 farthings or $4\frac{1}{4}$d. is the money spent by each.

14.

The least number that can be divide by 2, 3, and 4 respectively, without a remainder, is 12; and that there may be 1 remaining, the number must be 13; but this is not divisible by 5 without a remainder. The next greater number is 24, to which add 1, and it becomes 25; this is divisible by 5 without a remainder, and is therefore the number required.

15.

From the 12 remaining, deduct 1, and 11 is the number she sold the last boy, which was half she had; her number at that time, therefore, was 22. From 22 deduct 2, and the remaining 20 was $\frac{2}{3}$ of her prior stock, which was therefore 30. From 30 deduct 10, and the remainder 20 is half her original stock; consequently she had at first 40 apples.

16.

On the first view of the question, there does not appear to be any loss; for, if it be supposed that, in selling five apples for 2d., she gave three of the latter sort (viz. those at three a-penny) and two of the former (viz. those at two a-penny), she would receive just the same money as she bought them for; but this will not hold throughout the whole, for (admitting that she sells them as above) it must be evident that the latter stock would be exhausted first, and consequently she must sell as many of the former as remained overplus at five for 2d., which she bought at the rate of two a-penny, or four for 2d., and would therefore lose. It will be readily found, that when she had sold all the latter sort (in the above manner), she would have sold only eighty of the former, for there are as many threes in one hundred and twenty, as twos in eighty; then the remaining forty must be sold at five for 2d., which were bought at the ratè of four for 2d.—*i. e.*

A. d. A. d.
If 4 : 2 : : 40 : 20, prime cost of 40 of the first sort.
5 : 2 : . 40 : 16, selling price of ditto.
—
4d. loss.

17.

The least number that will answer this question is 12; for if we suppose that each Grace gave one to each Muse, the latter would each have three, and there would remain three for each Grace. (Any multiple of 12 will answer the conditions of the question.)

18.

When the first line of figures is set down, subtract 2 from the last right-hand figure, and place it before the first figure of the line, and that is the quotient for five lines. For example, suppose the figures given are 86,214, the quotient will be 286,212. You may allow any person to put down the two first and the fourth lines, but you must always set down the third and fifth lines, and in doing so always make up 9 with the line above, as in the following example:

Therefore in the annexed diagram you see that you have made 9 in the third and fifth lines with the lines above them. If the person desired to put down the figure should set down a 1 or 0 for the last figure, you must say we will have another figure, and another, and so on until he sets down something above 1 or 2.

86,214
42,680
57,319
62,854
37,145
———
Qt. 286,212

In solving the puzzle with three lines, you subtract 1 from the last figure, and place it before the first figure, and make up the third line yourself to 9. For example: 67,856 is given, and the quotient will be 167,855, as shown in the above diagram.

67,856
47,218
52,781
———
Qt. 167,855

19.

The man's age,—69 years 12 weeks; the woman's age,—30 years 40 weeks.

20.

The solution is as follows: First 4s.—

1s.=3s. 5s.—1s.=4s. (1s.=1 5-th of 5s. the barter-price of the wheat), and 3s.+2s.=5s. 4s.+2s.=6s. (2s.=1-3rd of 4s.+2s.), then, 5s. : 6s. : : 12*l.* : 14*l.* 4s. (=14*l.* 8s.), the barter-price of the horse, and hence $\frac{6}{20}$*l.* : 1 bushel : : have of A. The answer is thus proved:

	£	s.	d.
A has of B his horse, worth	12	0	0
With 1-5th of the barter-price of the wheat	2	8	0
	£14	8	0
B has 1-3rd of the barter-price of the horse	4	16	0
With 48 bushels of wheat, worth	9	12	0
	£14	8	0

21.

Out of the 8 pint jar fill the 5, and out of the 5 fill the 3; then 3 pints are left in the 8, and 2 in the 5. Empty the 3 pint jar into the 8, and it will have 6 in it; then empty the 5 (which had 2 in it) into the 3. Lastly, fill the 5 out of the 8 (which had 6 in it) and 1 will be left in the 8; then out of the 5 fill the 3 (which had 2 in it) and the 5 will have 4 in it, as was required.

22.

The four figures are 8888, which being divided by a line drawn through the middle, become $\frac{0000}{0000}$, the sum of which is eight 0's, or nothing.

23.

5,280 times.

24.

At first it seems evident that 20 days is the answer; but the first day it climbs 5 feet, loses at night 4 feet=1 foot. The second day it climbs 5 feet, and loses at night 4 feet=1 foot; so that together it has made 2 feet progress. On the 15th day it has climbed 15 feet, and during the 16th climbs 5 feet and reaches the top.

25.

As there were 365 days in 1847, and 366 in 1848, the difference would be

$$\tfrac{1000}{365}-\tfrac{1000}{366}=£\tfrac{100}{13359}=\tfrac{2000}{13359}\text{s.}=\tfrac{8000}{4453}\text{d.}$$
$$=1\tfrac{3547}{4453}\text{d.—Answer.}$$

26.

$5\frac{5}{5}+.5=6\frac{1}{2}$.

27.

Example:—

9764831	the sum of which
38	is 38, which subtracted from the
———	
9764793	first line, leaves the second, and

any figure struck out from this second line may be told on having the sum of the figures contained in it exclusive of the one struck out made known.

The solution is as follows:—Supposing the figure 6 to be struck out, the sum of the remaining figures is 39, which is four times 9 and 3 over; now the figure struck out is one which, added to the 3, would make up another nine; and in all cases the figure struck out will be found to be the one which would be required to complete a sum of 9. The only way in which a person can fail in solving this riddle is when either the number 9 or a cipher is struck out, as it then becomes impossible to tell which of the two it is, the sum of the figure in the line being an even number of nines in both cases.

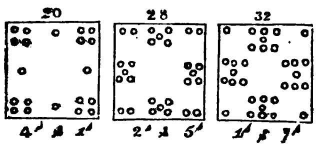
28.

As Fahrenheit divides the space on his instrument between the freezing and boiling points into 180 equal parts, called degrees, but places *zero* 32 degrees below the former point; while Reaumur divides the same space into only 80 degrees, and places *zero* where water begins to freeze; if therefore x be assumed = to the height on Reaumur's scale, then $\frac{9}{4}x+32$ will express the number of degrees at which Mercury stands on Fahrenheit's thermometer. But per question,

$$\tfrac{1}{4}x^3=\tfrac{9}{4}x+32 \therefore x^3-9x=128$$

whence $x = 5{\cdot}6325$—the height on Reaumur's scale, and $\frac{9}{4}x+32=44.6731$ =that on Fahrenheit's instrument.

29.



30.

51,500 steps.

31.

The answer will be the number of terms in an arithmetical series whose sum is 26292, first term 6, and common difference $\frac{1}{2}$.

$$s=\Big\{2a+(n-1)\,d\Big\}\frac{n}{2}$$

$$\text{or } 26292=\Big\{12+(n-1)\tfrac{1}{2}\Big\}\frac{n}{2}=6n+\frac{n^2}{4}-\frac{n}{4}$$

$$105168=24n+n^2-n$$

$$n^2+23n=10568$$

$$n^2+23n+\left(\frac{23}{2}\right)^2=\frac{421201}{4}$$

$$n+\frac{23}{2}=+\frac{649}{2}$$

$$\therefore n=313$$

The time required is 313 weeks, or 6 years, one of which is leap-year.

32.

Suppose two widows, Anne Jackson and Mary Dilk, not akin, to be left each with a son, and that Anne's son marries Mary, and Mary's son marries Anne; and that Anne's son has a son by Mary. Where Mary's son is the person that leaves the money. Here to his

				£ s. d.
Father,	who is	son,	is left	666 13 4
Mother,	the same	daughter,		666 13 3
Grandson,	as his	brother,		666 13 3
				£1,999 19 9

33.

From {SIX, IX, XL} take {IX, X, L} then {S, I, X} will remain.

34.

The greatest variety that can be in the number of hairs, is equal to the greatest number that any person has—, viz., one person having but one, another two, another three, and so on to the greatest number; but as, by the supposition, there are still more persons, whatever number they may have, some one of the preceding must have the same. Hence the proposition is manifest.

35.

Two-thirds of SIX=IX or 9.
One-fifth of SEVEN=V or 5.
and $9\times5=45$, the number required.

36.

Smith moved 200 yards backward with his face towards Thompson's, and Thompson 200 yards forward with his face towards Smith's.

37.

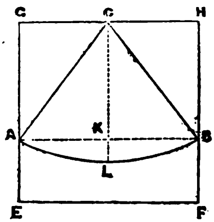
$1.25\times4=5.$

38.

$$\frac{2}{2^{2+2}}\quad\frac{2-\frac{2}{2}}{2}\quad\frac{2}{2-\frac{2}{2}}\quad\frac{2^{2+2}}{2}$$

denoting $\frac{1}{8}$, $\frac{1}{2}$, 2 and 8 respectively, the common ratio being 4.

39.



Let A B C denote the sector whose area is required; then E A = F B = 5; E F = A B = 12; E G = F H = 13; G C = C H = 6; and A G = E G — E A = 13 — 5 = 8.

```
Then 8        6
     8        6
     —        —
     64       36
     36
   ———
  100(10 = A C = B C, the length
  1        of the string, or the radius
  ——             of the sector.
  ·00
```

Also K C = A G = 8.

Hence, L C — K C = 10 — 8 = 2, the versed line K L.

```
                    2        2
Then 20            41        2
                  ——         —
        1·64   50)82·      3)4
        ———     ———       ———
        18·36    16·4      1·33
18·36)1·3333).072621    1·
      1·2852            ·072621 A L B.
      ———               ————
       ·4813            1·072621 the area
       3679                  12
      ————              ————
      11413             12·871452 ft.length
      11016                   5
     ————               ————
      ..3973            64·357260 ft. area
        3672         of the sector required.
       ————
        .3013
         1836
        ————
         1177
```

40.

120.

41.

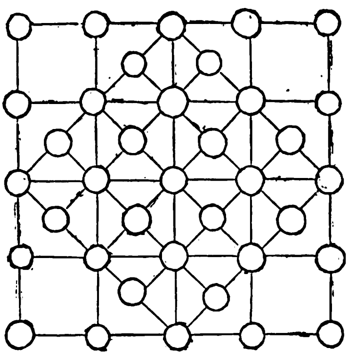
40,320 days; or 110 years, $142\frac{1}{2}$ days, reckoning $365\frac{1}{4}$ days to the year.

SOLUTIONS TO PRACTICAL PUZZLES.

1.

The Traveller must enter at the opening at the foot, and must pass between the lines forming the road to the Castle in the middle. There are no bars in the route: one road crosses another by means of a bridge, so that care must be taken that, in following the route, the traveller does not stray from one road to another, and thus lose the track. For instance, on entering, he will have to pass *under* a bridge of another road crossing over his path.

2.



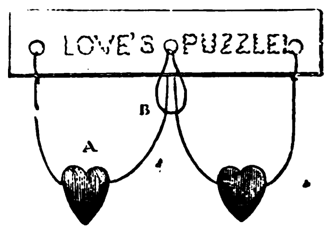
3.

4.

Thrust it upwards from the other side.

5.

First draw the heart A along the string through the loop B, until it reaches the back of the centre hole, then pull the loop through the hole, and pass the

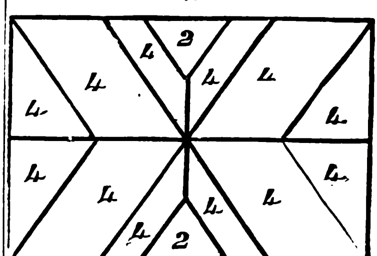


heart through the *two* loops that will then be formed; then draw the string back through the hole as before, and the heart may easily be passed to its companion.

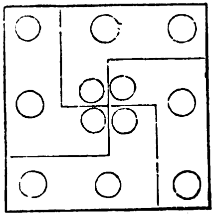
6.

The solution lies simply in these words, "Always slide one to the last point you started from." Thus, if you begin at F, and slide one to A, send one to A, and so on, till you have got the whole of them on.

7.

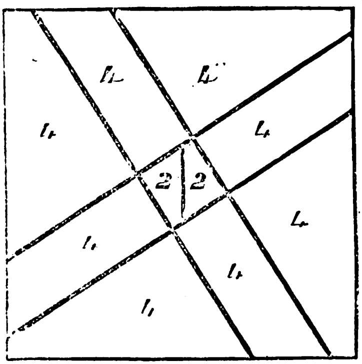


8.



There are two other ways of effecting this division.

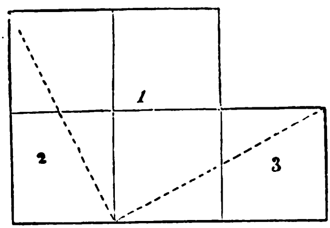
9.



10.

My ground is divided, my tenants at
work,
And he'll profit most who does not labour
shirk;
So let them toil on till cabbages rise,
And carrots and turnips to gladden their
eyes.
Gooseberries and currants, and rasp-
berries too,
Shall amply repay the work they may
do!

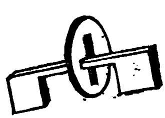
11.



Cut in the direction of the dotted lines, and it will then be easy to lay down the pieces to form a perfect square. A good plan will be to have a piece of cardboard cut to the shape of the diagram, another cut to the size of the square formed by the pieces divided as above, and also the pieces themselves. Then request the party you desire to puzzle to produce with the pieces the figures required.

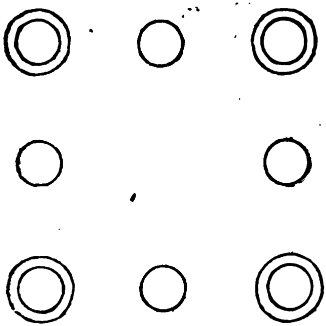
12.

Arrange them side by side in the short arms of the cross, draw out the centre piece, and the rest will follow easily. The reversal of the same process will put them back again.



13.

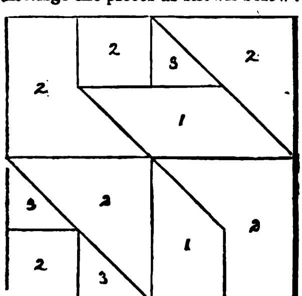
Have three at each side, and double counters at the corners.



14.

15.

Arrange the pieces as shown below:—



16.

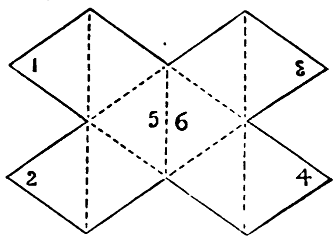
Blow smartly on one side of the egg, and it will hop into the next glass; repeat this, and it will hop back again.

17.

The counters being placed eight in a row, take the fifth from the left hand, and place it on the second; then take the third and place it on the seventh; then place the first on the fourth; and lastly, the sixth on the eighth.

18.

Cut the cardboard half through at the dotted lines, to enable it to bend the more readily; close the spaces between 1—2 and 3—4 by bringing the ends together; bend the whole between 5 and 6, and the seven-cornered box will



be produced; then fold the parts 1—2, and 3—4, underneath each other, and the six-cornered box will be formed; and by again placing the angular sections inwards, the remaining box will present itself.

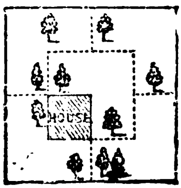
19.

Answer given with problem.

20.

The string must be put through the armhole, and over the head, then through the opposite armhole; then the hand must be put up underneath the waistcoat, and the string drawn down around the body until the former drops down about the waist.

21.



22.

Wrap a towel round the bottom of the bottle, and strike it evenly and repeatedly, but not too hard, against a wall, post, or tree, and after some time the cork will be driven out of the bottle.

23.

Place Nos. 1 and 2 close together, as in Fig. 1; then hold them together with the finger and thumb of the left hand horizontally and with the square hole to the right. Push No. 3—placed in the same position *facing you* as (*a*) in No. 3—through the opening at K, and slide it to the left at A, so that the profile of the pieces should be as in Fig. 2.

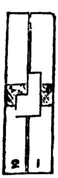


Fig 1

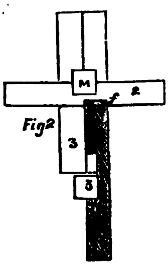


Fig 2

Now push No. 4, *partially* through the space from below upwards, as seen in *f*, Fig. 2. Place No. 5 crossways upon the part Y, so that the point R is directed upwards to the right hand side; then push No. 4 quite through, and it will be in the position shown by the dotted lines in Fig. 2. All that now remains is to push No. 6, which is the key, through the opening M and the cross is completed as in Fig. 3.

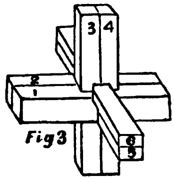
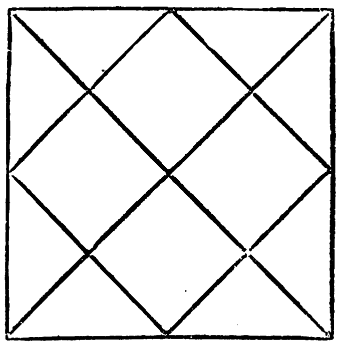


Fig 3

24.



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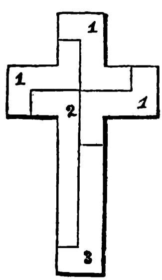

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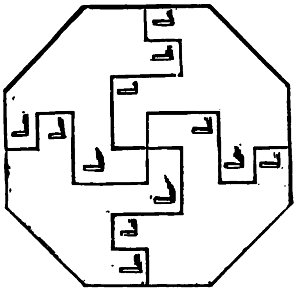
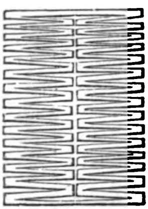


27.

Double the cardboard or leather lengthways down the middle, and then cut it first to the right, nearly to the end (the narrow way), and then to the left, and so on to the end of the card; then open it, and cut down the middle, except the two ends. The diagram shows the proper cuttings. By opening the card or leather, a person may pass through it!



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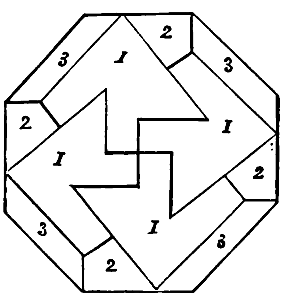


29.

The plank was to be cut in this way.—

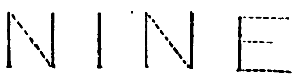
30.

After having placed the glass and coins as indicated, simply scratch the table-cloth with the nail of the forefinger, in the direction you would have the sixpence to move, and it will answer immediately. The table-cloth is necessary—for this reason the trick is best suited to the breakfast or dinner-table. The amusement will be heightened by reciting the following words prior to moving the finger:—

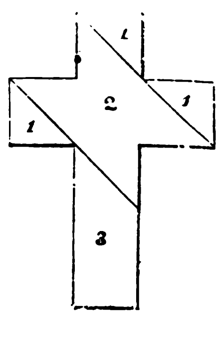
Little sixpence, do not stay
In a place so out-the-way;
But when my finger moved shall be,
Like a good fellow, come to me.

31.

Draw the lines in the direction of the dots.

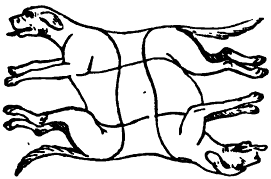


32.



33.

See now the four lines. "Tally-ho!"
We've touch'd the dogs, and away they
go!



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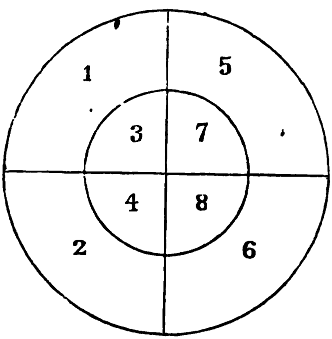
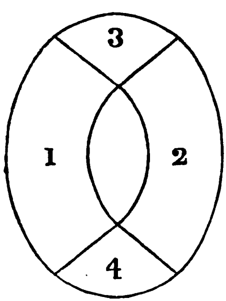
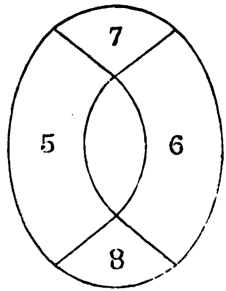
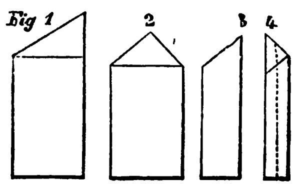






35.

Take a piece of writing paper about three times as long as it is broad, say six inches long and two wide. Fold the upper corner down, as shown in Fig. 1; then fold the other upper corner over the first, and it will appear as in Fig. 2. You next fold the paper



in half lengthwise, and it will appear as in Fig. 3. Then the last fold is made lengthwise also in the middle of the paper, and it will exhibit the form of Fig. 4: which, when cut through with the scissors in the direction of the dotted line, will give all the forms mentioned.

36.

Loosen the string, and draw the loop through the hole No. 2; pass it behind, and bring it through No. 1, and slip it over the smaller heart; then the string may be easily drawn out.

37.

Take one of the strings and pass it in a loop upward under the string which binds the wrist of the opposite person, then draw the loop through, and enlarge it, and by passing it *over the hand*, the release may be easily effected.

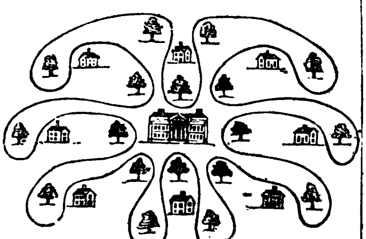
38.

Request the person to give you the cards containing the number, and then add the right-hand upper corner figures together, which will give the correct answer. For example: suppose 10 is the number thought of, the cards with 2 and 8 in the corners will be given, which makes the answer 10, and so on with the others.

39.

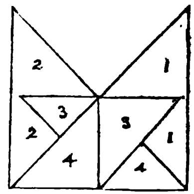
Blow with considerable force down one side of the glass upon the edge of the half-crown. The sixpence will be expelled by the force of the air, and will fall either upon the upper surface of the half-crown, or upon the table. A little practice will render the performance of this feat very easy.

40.



41.

Divide the figure in the direction shown by the lines, and you will have four pieces of the same size and shape.



42.

Take a round cylinder of wood of the diameter of the circular hole, and of the height of the square hole. Having

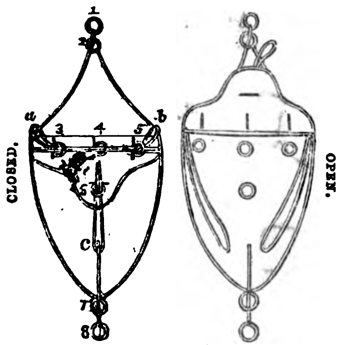
drawn a straight line across the end, dividing it into two equal parts, cut an equal section from either side to the edge of the circular base. A figure like that represented by the wood-cut above would then be produced, which would fulfil the required conditions.

43.

Draw the narrow slip of the leather through the hole, and the string and buttons may be easily released.

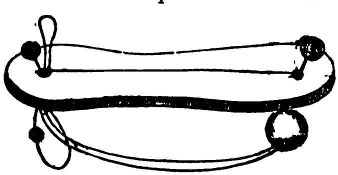
44.

Pass loop *a* up through ring No. 2 and over No. 1, then pass loop *b* over rings 1 and 2 up through No. 2, and over No. 1, as before; when the same may be easily drawn through rings 3, 4, 5. Again pass loop *c* through ring No. 7 over 8, draw it up through ring 6, and the purse is complete.



45.

Push the ball close up to the wood, and pull the loop of string down through as much as it will come; then pass the end of the loop through the hole in the wood and over the pellet as here shown.



The two loops will then separate, and the ball can easily be taken off.

The knots beneath the wood prevent the loops being pulled through by the pellets.

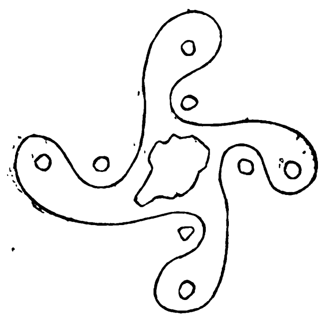
46.

Take away the pieces numbered 8, 10, 1, 3, 13, and three squares only will remain.

47.

Let Black Queen's Rook's Square count 1, (as in the diagram,) Black King's Rook 8, and count all the other Squares in the same way from 9 to 64. Place the Knight upon Black King's Rook's Square, 8, and move as follows:—23, 40, 55, 61, 51, 57, 42, 25, 10, 4, 14, 24, 39, 56, 62, 52, 58, 41, 26, 9, 3, 13, 7, 22, 32, 47, 64, 54, 60, 50, 33, 18, 1, 11, 5, 15, 21, 6, 16, 31, 48, 63, 53, 59, 49, 34, 17, 2, 12, 27, 44, 38, 28, 43, 37, 20, 35, 45, 30, 36, 19, 29, and 46. It may be well to chalk the figures on the board, as a guide, until the feat is well understood.

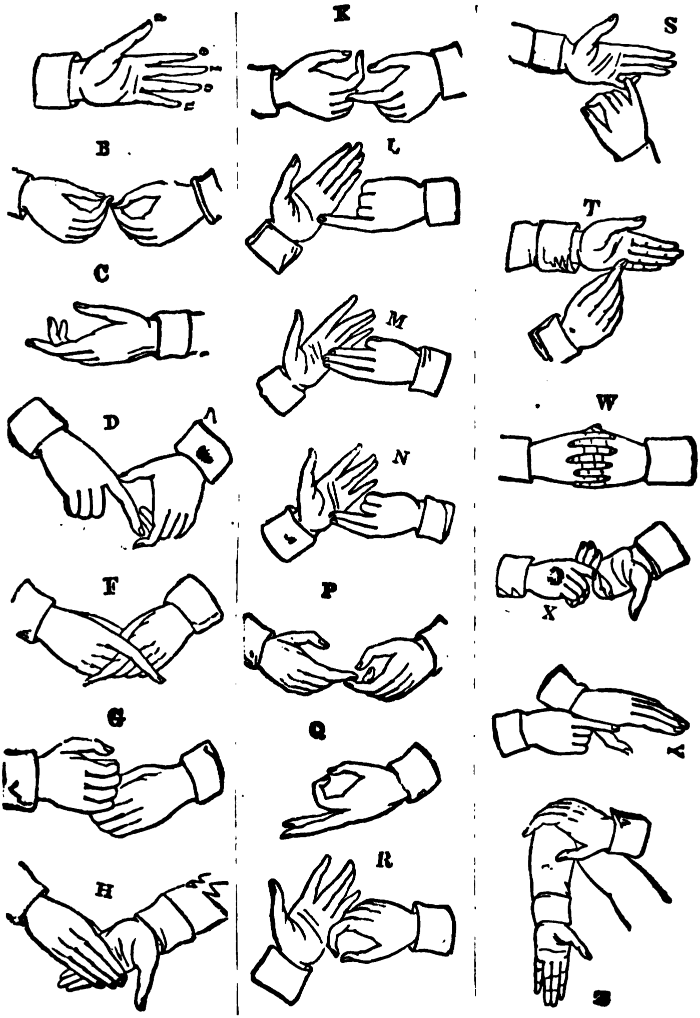
48.



49.

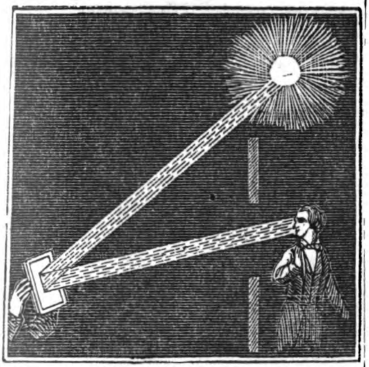
Enter at door No. 1; then pass on to the following numbers—15, 20, 8, 13, 40, 19, 36, 12, 3, 32, 43, 10, 50, 33, 41, 28, 37, 25, 11, 22, 39, 30, 7, 35, 26, 34, 46, 38, 2, 45, 14, 42, 31, 5, 24, 21, 29, 6, 18, 49, 4, 27, 48, 9, 51, 17, 23, 16, 35, 44, 52, 58, 55, 57, 60, 56, 53, 54, 61, 59, 62. You then return in the same order from 62 to 59, 61, 54, &c. &c.

DEAF AND DUMB ALPHABET.



OPTICS.

WITH A BIT OF LOOKING-GLASS YOU MAY THROW THE LIGHT OF THE SUN UPON AN OBJECT IN THE SHADE.



In doing this you adjust your reflector so as to make the angle of the reflected rays thrown upon the object, equal to the angle of the incident rays proceeding from the sun.

HOW TO MAKE FIVE SQUARES INTO A LARGE ONE WITHOUT ANY WASTE OF STUFF.

Suppose you have five squares of cloth, or anything else, as in fig. 1; find the centre of one side of four of these squares,

Fig. 1.

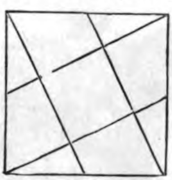
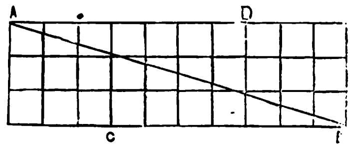


Fig. 2.

and cut them from that point to the opposite corner, then place the perfect square in the centre, and the other pieces round as in fig. 2.

DECEPTIVE VISION.

The following sleight shows how easily the eye may be deceived. Take a piece of pasteboard an inch and a-half in width and five inches in length, and



divide it by inked lines into thirty squares, then cut it from corner, so as to form two triangles. After this cut off the top of the triangles at C and D; (*i.e.*, at the fourth square from the right angle) and arrange the pieces in this manner:—

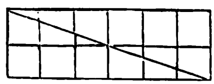


Fig. 3.

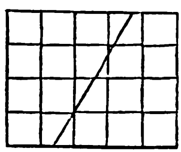


Fig. 4.

On counting the squares in the first figure, there appear to be thirty, but the other arrangement of the same card seems to contain thirty-two. It does so, however, only in appearance, but it is only a very correct eye that can detect the imperfection.

DRINKING WATER THROUGH A STRAW.

What little boy has not sucked water through a straw? People familiarly call this sucking, and they sometimes say, that *suction* causes the water to rise in the tube; but this is far from being a satisfactory explanation of the fact. When you suck at the upper end of the straw tube, you first draw all the air out of it, leaving a vacuum or void in the upper part of the tube; then the pressure of the air upon the water (outside of the straw) causes it to rise up the tube—in fact, the process of sucking takes away the pressure of the air from the water standing inside of the tube, while the pressure of the air upon the water outside of the tube causes the water to rise in the tube.

DEAR BOYS.—In taking a regretful leave of you and the "Treasury" we have arranged for your amusement and edification, we affectionately ask you to give due attention to each section of the volume. Let not the Sports and Pastimes, and the other lighter portions of it, absorb all your leisure. You will find the Marvels of Science, the Wonders of the Animal Kingdom, the charms of Rural Affairs, and the great works accomplished by the genius of man, if studied in the right spirit, will yield the highest entertainment, and enrich your minds with useful information.