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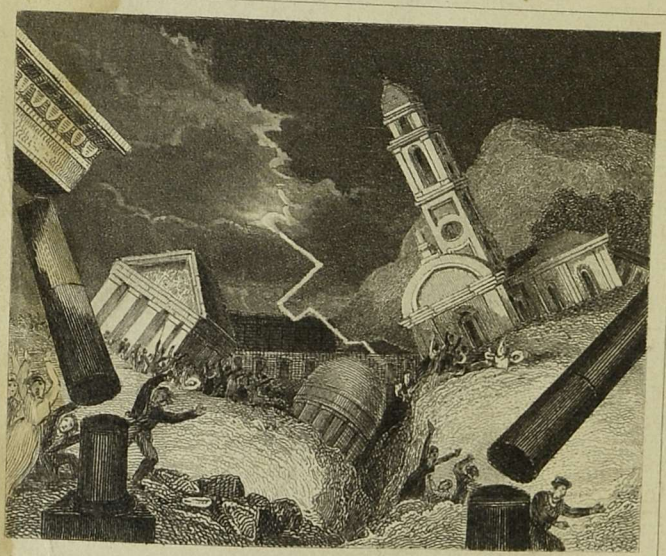

Earthquakes.

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A NEW

DESCRIPTION OF THE EARTH;

CONSIDERED CHIEFLY AS

A RESIDENCE FOR MAN.

By JEFFERYS TAYLOR,

Author of "The Little Historians," "Esop in Rhyme," "The Forest," &c.

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A NEW

DESCRIPTION OF THE EARTH.

I REMEMBER once observing a very small insect, scarcely bigger, perhaps, than the foot of a common fly, which had alighted from its airy vehicle, on a two-feet terrestrial globe in my study. The little animal was proceeding with great activity in its pedestrian labours over the surface of the world beneath it, when I took a magnifying glass of high power, by which to watch, with more accuracy, its motions. I perceived it had six legs, two wings of wondrous elegance, and feelers proceeding from

the head. Judging from the incessant use it made of these, and from the frequent elevation of its head, it was probably, like other travellers, intent on an expedition of discovery; but I found, on a further view of the matter, and on considering justly the real proportions of things, that this almost invisible adventurer was a giant in size, exceeding in altitude the highest mountain in the world; whilst its nearly viewless legs gave it the speed, not of an eagle, but of a cannon-ball! According to the best calculation I could form, an animal which should make as great a figure on the surface of our earth, as this insect did on the two-feet globe, and which should perform as well, must be quite seven miles in length or height; must take two or three miles at a step, and must move its legs faster than the spokes of a gig-wheel, when revolving at its greatest velocity. The fact indeed was, that the insect, which to

the naked eye seemed only slowly to creep, had, in that morning's excursion, made its way from the North of Scotland to Grand Cairo; and this, in time which would scarcely allow me to reach our parish church!

But if the little creature so far surpassed us when on foot, how much more, when it suddenly vibrated its tiny wings, and suspended itself at the distance of about two full inches from the globe! This was the same thing, as if the monster I have supposed had expanded pinions large enough to cover London, and had mounted, in a moment, to the height of seven hundred miles above our heads!

"And now," thought I, "my little enterprising atom, what can you see, supposing your eyes are good? There are no clouds to intercept your vision, and, no doubt, the pros-

pect must be vast. It makes one giddy to realize the view. London and Constantinople—or, rather, the countries in which those cities stand—would be visible at the same time; and the earth would then appear as large as the two-feet globe, at two inches' distance from the eye. Whilst I mused on this thought, my diminutive explorator had entirely disappeared, leaving me to make what use I pleased of his apparently undesigned, and unimportant visit.

It was evident to me that the insect, although such a giant compared with the globe he traversed, could form no idea, if it had been desirous so to do, of the size and real figure of that sphere. The surface on which he walked must have appeared a plain to him; and if a speculative philosopher, he very probably favoured the notion, like some of the learned ancients and *ignorant* moderns, with respect

to our earth, that it was an extended, flat surface; and although it continued walking, till its feet, being near the South Pole, were opposite the spot they had occupied on the Northern Hemisphere, I dare say it considered the surface merely as part of the same plain and level expanse. I am not at all sure that, when it took wing, and obtained a distant view of the globe, any better notion of its form was conveyed, than that it was a circular, flat surface, like a trencher.

It is no wonder then that we, who bear no proportion on this earth, to the size of that animal on the twenty-four inch globe, and who cannot assist our observations by rising hundreds of miles from the surface, should be quite unable, from what we see of the ground beneath us, to form any conceptions of its bulk and figure. But though our bodies are infinitely

minute in comparative size, and are yet, as it were, tied down to the earth by their weight, so that we cannot inform ourselves of the truth by any view we can obtain of the globe, our *minds* are not so limited; and though the earth is too close to be seen, the *heavens* are not; and from observations of these, and other matters connected with the subject, thinking men have long been able to give as true an account of the earth, as if they were big enough to use it as a cricket-ball for their diversions.

As there are many books already, large and small, which treat of the heavens, under the name of Astronomy, and of the terrestrial globe, its uses, lines, and figures, under the term Geography, with an account of the lands and seas on its surface; I shall not consider those subjects much in the present little volume, but shall describe the earth, its situ-

ation, motions, figure, dimensions, and materials, chiefly as *a residence for men and animals;* and shall just point out, as I go along, those sciences which arise from these studies of nature.

On this plan, therefore, I must just hint, in the first place, that Astronomy, or the science of the heavenly bodies, is the most ancient study of man; and it is the most useful in enabling us to acquire true information respecting the figure and motions of the earth itself, which is in fact one of these heavenly bodies.

By observation of the heavens, we see plainly that the sun, moon, and stars are not merely lamps and candles for us to see by; but that they are spheres, globes, balls, some of which shine by light of their own, others by borrowed lustre. We see, too, that some

of these bodies change their place in the heavens, whilst others do not; and it appears further, that the former are those which shine with reflected light.

How then do these wanderers, or planets move, and whence do they obtain their effulgence? These enquiries have been long satisfactorily answered by men of observation and thought. If I see, for instance, a fire on the ground, on a dark night, and persons, brightly red in colour, moving about it, I cannot doubt that the light proceeding from them is supplied by that fire; and this is still more evident, when I see that their bright side is always next that central flame.

Now, any one has eyes and wits enough to find out as much as this, with regard to the planets, if he will but use them. There are some

half-dozen planets visible enough to the naked eye, which revolve round the sun in endless circles. Perhaps we may see a reason for this presently. I said that these are visible to the unassisted eye: one of them especially is so near and conspicuous, as to hide, at all times, more than half the heavens from us, and is seen by day as well as night! I need not surely name OUR EARTH, which occupies, as a rolling planet, the third place in that visible company of worlds, called, with our central and common sun, the Solar System.

I must refer to books of astronomy for a particular account of these, their distances, size, motions, and appearance; wherein also the little that is known concerning the fixed stars, comets, and other heavenly objects, is contained. Our business, at present, is with our very near attendant, the Earth. It must

not, however, be forgotten, that the Earth is one of these planets, and appears to them as they do to us, with this difference, that our globe is somewhat larger than some of them, and considerably smaller than others.

DIMENSIONS, FIGURE, AND MOTIONS OF THE EARTH.

We are to bear in mind continually in our present enquiries, that the Earth has been destined, and therefore constructed, by the great Author of nature, for the residence, support, and comfort of conscious beings, whose innumerable hosts occupy, to an extent beyond our calculations, the vast accommodation for them prepared.

And now, with regard to the shape and dimensions of the Earth, it is quite certain that

we have not the wings of the little insect I have mentioned, whereby to rise, and take a wide survey; nor have we the advantage of his comparative size, which would enable one to stalk from Johnny Groat's house to Grand Cairo in a morning, or to follow the setting sun round the globe in four-and-twenty hours. It is doubtful, as I said before, whether, if we could so do, our notions would be correct upon the subject, without those further powers of observation and of thought which enable the *mind* to ascertain the matter whilst the body remains at rest.

It is not needful, I presume, to draw forth an argument, a hundred miles long, to prove to any one in the present day, that the earth is a globe. I will therefore only state the three usual proofs, in not many more than three words.

In the first place, then, no man could persuade either you or me, if we perceived upon a wall, a shadow which had long ears, that the substance which cast that shadow had not long ears also; especially if, during various motions of that figure, those long ears should always appear the same; we should say to the person who endeavoured to convince us to the contrary, that it must be his own shadow—that of a genuine donkey. But suppose, instead of an irregular shape like that, we saw continually a plain, circular one, and knew all the while that the body which cast it, was continually turning round in various directions; it would be vain then to tell us that that substance might be flat like a plate, square like a block, long like a candle, or irregular like a simpleton's head. It must be a globe. Now, when the earth's shadow falls upon the moon, in an eclipse of that little planet, the shape of

that shadow is always circular. This fact, therefore, is proof enough to those who can reason at all.

But again, if the earth be not a globe, but a plain, how is it that we cannot see Turkey from England, unless we rise some hundreds of miles to look out? How comes it, that except from hills and mountains, we scarcely ever see further than three or four parishes at a time; and that at sea, where the shape of the earth is not subject to the inequalities of the land, ships are not discerned at all at a few miles' distance, but when they first appear show their top-masts, and then, by degrees, the lower parts? There is, however, one other question, absolutely posing to those who would hold that the earth is a trencher-shaped concern. How comes it to pass, that voyagers have sailed round, and arrived at the

same spot again, without coming to any edge, corner, or other projection, such as a fly must encounter, who would proceed from the upper to the under side of a plate? But I have needlessly exceeded my three words.

And now for the size of this globe. Here one is more puzzled to give the true notion; for it is much easier to conceive of forms, than of dimensions, especially when these last are to be represented by numbers, because they exceed the compass of our bodily senses. However, we must go on, and do the best we can. I believe I stated sufficiently, that the smallest insect, on a two-feet globe, is bigger than a mountain on the surface of the earth: but we must now proceed to the real dimensions of our verdant planet.

The earth then is, as we have seen, a

globe, or very nearly so. Very well:—that globe in the study would require a gimlet, two feet in length, to bore a hole through its centre to the other side. Now, how long must the gimlet be, to perform the same operation on the earth? Consider, and conceive, if you can, of the size of this ball, when I tell you, that the instrument must be seven thousand nine hundred and seventy miles in length, to pierce straight down, entering, we will say, near London, and coming out not far from New Zealand, in the Southern Ocean! Think again, how long a single mile is. There are one thousand seven hundred and sixty yards in a mile; and you take, in walking that distance, nearly five thousand steps. Your globes, or those on which young persons usually learn geography, are perhaps eighteen inches, or two feet in diameter. But suppose they were so large that they would not go in

at the door, or were even so very large, that they would not roll along between the houses in the street. You and every body would say, what immense globes! And if a globe *could* be made *one mile* in diameter, it would be a thing tremendous to look at; it would seem as if it would crush the earth to pieces by its weight. But remember, the earth is nearly *eight thousand miles* in diameter; and the other would scarcely look bigger than a pea upon it.

However, after all I cannot, as I could wish, give an idea of the awful grandeur of so prodigious a ball as that whereon we live. If indeed you were raised a thousand miles high, and then were to look down, you would understand it better; for then, as far as your eye could reach, you would see nothing beneath you, but earth, earth, earth—and yet it would be, you know, a thousand miles off!

If, however, you *could* form an idea of the actual dimensions of this globe, and were placed so as that you could *see its size*, you would perhaps be ready to ask, what does it rest upon? How can any thing possibly *bear its weight?* The Chinese philosophers, thinking the earth is very heavy, say that it stands upon the back of an elephant; which is about the same thing as if the globe, a mile in diameter, were to stand on the back of a black beetle. So *this* supposition, you see, will not do at all. The earth must have better support than that, or else *none whatever;* and if we examine the subject, and think about it properly, we shall find that it really *has* no support, that it *needs* none, and that if there were any thing upon which it could possibly rest, it would fall to pieces by its own weight. Did you never see a very large plum-pudding—no offence to the cook—fall asunder in the dish, as soon as placed upon it?

Yet that round pudding, if floating in water, would perhaps hold together. So the earth, whilst it touches nothing but the surrounding air, will remain entire; but if it were to come near any other planet, or a comet, so as to touch, it would perhaps fly into a million of fragments by the blow; or if it were even placed gently against it, it would then, as I have said, part asunder by its weight.

Here, then, we see the infinite wisdom of Him, who, as David says, "HANGETH THE EARTH UPON NOTHING." I wish I could explain this so as that you might not wonder and be puzzled at it. Let us each try what we can do, in clearing up the mystery. You are surprised, I suppose, to find that the earth has nothing beneath it to support it, and are astonished that it does not *drop down somewhere.* Now I, for my part, should wonder

much more if it *were* to drop, as you say; for then I should know there must be something prodigiously large underneath it, to *attract* it. Attend now to my explanation. Suppose you have an orange in your hand: you know, if you cease to retain it, it immediately passes from you; but where does it go to? It falls to the floor, and gets as near *to the earth* as it can. But suppose, now, that the earth itself were removed quite away, and that there was nothing at all, within millions of miles of the orange, do you think it would fall *then?* Oh no! If there were nothing but the orange in the place where the earth now is, that orange, unless put in motion, would remain at rest, because there would be nothing to move it; but if it were once put in motion, it would be *always* moving, as the earth now is, because there would be nothing to stop it.

I shall not say a great deal more about this; for I am a little afraid that you are not quite old enough to comprehend the matter completely. Whether, however, you can understand it or not, I must just tell you that things are made to fall to the earth by a power, or law of nature, which no one can explain, called *the attraction of gravity*. It is this which makes an apple, or a stone, or any thing and every thing descend to the earth, when it is at liberty to move. But what the attraction of gravity *is*, no philosopher can ever tell you. All we can say is this—that if it were not for this power which the earth has of pulling or attracting things towards itself, and thus keeping them steady, every thing that is loose would, as the earth turns swiftly round, fly off from it. All the houses and people in the world would be scattered in the air in an instant, if it were not for this invisible

power. For my part, I think the wisest thing we can do, is to acknowledge that this principle, or law of nature, as it is called, is nothing else but the effect of the almighty power of the Supreme Being, which is in constant exercise to keep the worlds he has made in the state in which they are required to be, as habitations for creatures. True it is, we should call it a *miracle*, if a solid lump of iron, for instance, were to be suspended in the air, without any apparent power of supporting it. But though not a *miracle*, it is just as *wonderful* to a philosopher who thinks about it, that it should *fall*, though unsupported, as it would be to an ignorant man, that it should remain suspended. Neither the philosopher, nor the clown, in either case, could explain the *cause* of the thing in question. We are too apt to call only those things *wonderful*, which are *unusual;* if we were to call every

appearance wonderful, which to us is *unaccountable*, we should do better, and should then be obliged to refer to the immediate act of God every effect in nature and providence, whether common or uncommon; for each is alike incomprehensible to us.

But though we cannot explain the nature of the attraction of gravity, we can easily discern the reason and use of it; for as I said just now, it is this which keeps the things on the earth, and perhaps the earth itself together; the earth having a power of drawing or attracting all substances towards its own centre, this makes things, as we say, *fall* or descend, and feel ponderous or heavy. But as these bodies would *not* fall, or descend, if the earth were not near to attract them; so the earth itself does not descend, because there is nothing near by which *it* can be attracted. There-

fore, as it has nothing to make it descend, it cannot want any thing to rest upon; and as it wants nothing to rest upon, it is no wonder that it rests upon nothing.

And now, let us stop a moment, and think how admirably all this has been ordered and adjusted by the wisdom and power of the Almighty. He intended to create men and animals, and he determined to construct them a world suitable for their residence. He made it *a globe*, because any other shape would have produced awful shadows, and irregular days and nights, and slanting continents, of prodigious extent. All oceans and rivers would have rushed furiously to certain parts, and other parts would have been utterly dry; as, for instance, if the earth had been square or oval. He made it a *globe*, then, that none of these inconveniences might occur. He then placed it

at such a distance from the sun, that his light and heat might be suited to the creatures to be formed thereon:—and then what? Was the globe fixed in an immoveable position, to endure endless night and winter on one half its surface? Certainly not: we see nothing like this in any of the works of God. It was necessary, for the life and comfort of those creatures, that they should in turn enjoy the blessings of changing days and seasons. For this purpose, either the sun or the planet must have appointed motion. Now the sun, I believe, is as large as all the planets put together; and it would by no means answer the same purpose to send him round the solar system, as to cause the worlds of that system themselves individually to revolve. So they are wheeled in circles about their central fire, and thus, without confusion, enjoy his vivifying beams in common.

But the motion *round* the sun, called the *annual* motion, would make a year and a day the same thing: a dreary disappointment this, and one which would not have rendered it possible for the works of man to be completed. Each planet, therefore, has a motion, called *the diurnal*, on its own axis, or central line, like a joint of meat on the spit before the fire. Our earth makes about three hundred and sixty-five of these revolutions in a year; so that day and night come exactly often enough for the twofold requirements of rest and labour.

But it is plain that neither the annual, nor the diurnal motion, nor both together, would give us *seasons*, which are to the vegetable world, what day and night are to man, without some further contrivance. This is called the *inclination of the earth's axis*, which I will endeavour to explain. It will, however,

render that explanation more clear and easy to both of us, if we take a little notice first, of some of the terms used in the study of the artificial globe.

This little wooden world, made to represent the great one, cannot be sustained or used without many things which the earth herself can do vastly well without, and which indeed would greatly encumber her in her motions: particularly the mahogany frame, and the brass meridian, with the poles and sockets; to furnish which, if needful, all the wood and metal in the world would not be enough!

Now, we have seen that the earth has a diurnal motion on its own centre, and this, you see, the artificial globe has; for it turns freely round on the pins or poles, at opposite points of its surface. The earth needs no such sup-

ports; but still it revolves, and the points round which it moves, are called the North and South Pole. I need not say that the North Pole is that situated within the Greenland seas, and the South Pole is that which answers it below. Let us now suppose that a man were standing exactly on the point which forms the North Pole of the world, (I would advise him to wrap himself up in a dozen bears' skins, and smoke a good cigar to keep out the cold,)—I say, he, standing just there, would move thousands of miles in a day, with the earth in its orbit; but he would move thousands of miles less than those who, like ourselves, are neither able nor willing to occupy his place. He would move once round on his axis, which would be the earth's, in twenty-four hours. Small amusement, certainly! If, however, he were to step one yard from his place, then the earth would accommodate him

with a circular ride of about six yards in the day: if he were to proceed one mile away, he would, of course, be carried still in a circle to the extent of about six times that distance, in the twenty-four hours; because the Pole is the centre of the circle, and the distance to the centre is half the diameter, and the diameter is *about* one third of the circumference.

It is not, therefore, very difficult to find out the distance to which *we* are whirled in a day, by this same diurnal motion of the earth. London, I should say, proceeds thus at the rate of *about* sixteen thousand, two hundred miles in one day: whilst by the *annual* motion, the whole globe is borne onward at the rate of sixty-eight thousand, two hundred and forty-three miles in that short period of time, an hour!

So much for the Poles. The next thing to

be mentioned is the Equator; a line, which you see, is drawn round the globe, exactly at the same distance every where from the Poles. The earth itself has no such thing as this. It is useful for geographical purposes, in finding the exact situation of places by the *longitude*, which I shall come to presently; it also is called the equinoctial line, because, when the sun shines at noon, not slanting, but perpendicularly down upon those parts under that line, the days and nights are of an equal length all over the world. This is twice a year—on the 21st of March, and the 23rd of September. The sun then rises at six, and sets at six, as you are aware. The 21st of March is called the vernal equinox, the 23rd of September is the autumnal equinox. I can only just mention these things, so that you may just know what is meant by the terms; I do not expect you, at present, to understand every thing connected with them.

That yellow, brass circle, or ring, in which the globe moves, so as that, in turning, all places pass under it, is called *the Meridian;* because it shows the place in which the sun appears at *mid-day*, or noon. At twelve o'clock, the sun is said to be on the meridian. There are lines, you will see, on the globe, crossing the equator, and meeting at the poles. These are called meridianal lines. The sun passes one of these, or rather, one of these passes under the sun every hour, as the earth turns round. Therefore, when it is twelve o'clock with us, it is *one* o'clock with those who live under that meridianal line which is next to ours on the east of us; for the sun passed that, and it was noon there an hour before. So, on the other hand, with those who live under that line next to ours, on the west, it will be only eleven o'clock; for it will be an hour before the sun will reach their meridian,

and before it can be noon to them. Perhaps you thought that when it is twelve, or one, or any other hour, with us, it must be the same hour of the day all over the world; if you did, you were strangely mistaken. With a globe at hand, it is, however, easy to tell what hour it is at any part of the world. Suppose the clock is striking, we will say, seven. You have nothing to do, but to count the meridianal lines, beginning at that which passes through London; calling that *seven*, and so on regularly to the line which runs through, or near the place you are thinking of. If the city is east of London, as Constantinople, then reckon them forward, as seven, eight, nine, and so on, till you come to that city; but if the place is west of London, as New York, then count them backwards, seven, six, five, and so on. You see now some of the uses of the meridians.

The Ecliptic is a line which runs slantingly over the Equator; but both you and I must be wiser than I am afraid we are, to understand each other clearly about this, without an actual globe on which to explain it; I can only say, that the Ecliptic marks the path through which the sun appears to pass in the year. I should like very much to exhibit this and other things on the globe I am describing; because I should show you, at the same time, exactly the way in which the seasons of the year are produced: perhaps papa or mamma will be so good as to do it.

The Tropics. Do not you see on the globe two lines, one above and another below the Equator? That which is north of the Equinoctial line is called the Tropic of Cancer; that on the south is the Tropic of Capricorn. The use of these lines on the

globe, is to show how far north and south of the equator the sun shines *vertically*, or directly overhead. You know, that in England, when the sun is at the highest, which he is on the 21st of June, at twelve o'clock, he is yet not over your head, nor near it. But between the Tropics, at noon, he is actually up in the very middle of the sky, shines perpendicularly down upon the tops of people's heads, and therefore makes the shadow of a man a round thing, like a dish under his feet, in which he walks. It is this direct and downright shining of the sun which makes those countries so insupportably hot as they are. The sun is vertical all round the earth at the Tropic of Cancer on midsummer day; and he is vertical at the Tropic of Capricorn when it is mid-winter with us, that is, on the 21st of December. I may as well mention here, that the space between the tropics of Cancer and

Capricorn is called the torrid zone; that is, you know, the hot zone.

There are two circles, you will perceive, at a little distance from the poles; that round the North Pole is called the *arctic*, or northern circle; that round the South Pole is the *antarctic* circle. Those parts of the earth which are contained within these circles are called the frigid zones, and not without reason; for, as I mentioned before, the polar regions are cold in a degree that we can scarcely conceive of. Now attend to what I am going to say: you know that with us there are three hundred and sixty-five days in a year, some of which are much longer than others; but it is absolutely the fact, that under the poles *there is in the whole year but one day and one night, each of which is six months long!* During half a

year the sun never sets, and that is their summer; and during half a year, also, he never rises, and that is their winter! With the assistance of a globe and a lighted candle, I could explain this to you in one minute. I am not sure whether mere words will do it, so I will try to put you in a way of explaining it to yourself, if you have not a globe at hand, or if papa is not in the way to show you what I mean.

Take an orange, and thrust a wire, or a small skewer through it, so that you can hold of both ends, to turn the orange round with it. Then, when it is dark, place one candle upon a stool in the middle of a room, and hold your orange (which is to represent the earth) level with the flame of the candle, and at a distance of about the length of your arm from it—very well; but now, do not let the wire

by which you hold the orange, be exactly upright; but let it incline, so as to point to some particular spot in the upper part of the wall *opposite* you.* Quite right again. Keep the wire pointing in that direction as steadily as you can, and turn it round in your fingers at the same time. The upper end of the wire will be then like the North Pole of the earth, the lower end will be the South Pole, and the candle, you know, is intended for the sun. You will now perceive, if you hold the orange just as high as the candle, that whilst you keep turning it round, the light will shine constantly upon one pole, and perhaps a little beyond it, (if your hand be not in the way,) and that the opposite pole will be as constantly in the dark; but if you walk round the candle,

* Perhaps some one a little older will have the goodness to assist the youthful philosopher in performing this little experiment.

and turn the orange in the same way, keeping the North Pole still directed to the same spot in the wall, you will find that the light will shine as constantly upon the *South Pole*, and the North will be in the dark. Thus, if you walk round, always having your face to the candle, turning the orange, and keeping the pole, or wire, always pointing the same way, you will see pretty clearly how the earth moves round the sun.

I said that the spaces within the polar circles are called the frigid zones; that between the tropics you know is the torrid zone. The two spaces between the frigid zones and the torrid, are the temperate zones; and those, because the heat and cold are moderate, are by far the most delightful regions of the earth. There are, you see, five zones—two frigid, two temperate, and one torrid.

The next thing to notice on the artificial globe, is the horizon; that broad, flat, circular frame which encloses it, and which has figures and animals represented upon it: these are called the Signs of the Zodiac, the use of which, I think, you cannot understand at present.

Latitude and Longitude.—The distance of any place north or south of the equator is called *the latitude* of it; and the distance of any place east or west from the first meridian is called *its longitude.* These two enable us to find exactly the situation of any city, or other particular part. The equator, you will see, is divided into a great many degrees, and so is the brass meridian. There are three hundred and sixty degrees on each: the degrees on the meridian going up and down, north and south, show us the latitude; those

on the equator, east and west, give the longitude; but this can only be properly explained on the globe itself.

Thus I have attempted to describe the artificial globe, and have endeavoured to show you its use, and the reason of the various lines and figures upon it. I should like to know how far you have tried to understand me, or whether you have passed it over hastily, in order to find something more amusing. I readily own that this part of our subject has not been so entertaining as probably some future parts may be; it is however very important, and if I had omitted it, and were to leave out such information, my book would not be worth reading. Do not forget to look at the print of the globe, which has most of the things I have mentioned, marked distinctly upon it.

The real earth, although it has no such lines and circles upon it, as that we have been examining, in other respects pretty nearly resembles it.

So the artificial globe is a good model, as it is indeed a good likeness, which we shall presently see, of the earth, which it represents; and the lines and apparatus about it are needful means for the explanation of the motions and circumstances to which our round whirling residence is actually subject.

THE TERRAQUEOUS GLOBE, OR THE FEATURES OF THE EARTH'S FACE.

We have now taken some notice of the figure, dimensions, situation, and motions of the earth, and have observed how these particulars are arranged for those purposes to which the globe has been destined, as an abode for men and animals. So far as we have gone, however, we have only beheld a vast moving machine, adapted to the conveyance of infinite millions of passengers, who are supplied with light and heat by that method of procedure. We have not, as yet,

attended to any other accommodations for the travellers, on this mighty vehicle. In fact, we know as much respecting the moon and the other planets, as has been here stated of the earth.

The first thing to be noticed now, with regard to the earth's surface is this—the distinction of solids and fluids. All the materials we have to do with here belong to one or the other of these classes; and with respect to *the features of the earth's face*, the grand separations of land and water, form nearly the whole of the art which teaches us to represent her surface. The oceans, the seas, the gulfs, the lakes, the creeks, the rivers, are the forms in which the waters present themselves to our view; then continents, peninsulas, islands, capes, promontories, mountains, are some of the shapes in which the land, or solid parts,

occupy their place. I must give my own explanation of these, and some other matters, in order to be sure of being understood, when I use the terms hereafter. But I am far from supposing that my readers, generally, are entirely ignorant of the common words and phrases of geography. I am indeed supposing, all the way through in this little work, that they have had some access to other sources of information, on the express subjects of astronomy and geography; so I only refer to them as occasion happens to lead us that way.

By *an ocean* is meant one of those immensely large and wide collections of water, which are but little divided by the land, as the Atlantic Ocean, and the Pacific Ocean, the first of which is three thousand miles across, and the other is not less than ten thousand miles from one side to the other!

A sea is some part of the ocean near a particular country, or shore, and often has its name from the land it joins, as the Irish Sea. When the sea runs up a long way into the land, it is called *a gulf;* if a very long and large one it is called an *inland sea ;* such are the Mediterranean and the Baltic. When it does not go up far, but is rather wide than long, it is a *bay*, as the Bay of Biscay ; if it be smaller than a bay it is called a *creek*, or *haven.*

When two seas join each other by a narrow communication, it is called a *strait*, or *straits*, as the Straits of Gibraltar ; and if so shallow as to be measured, or sounded with a line, it is sometimes called a *sound.*

But there are waters of large extent *entirely* surrounded by land ; these are called *lakes*,

as the Lake of Geneva. There is a very large lake of *salt water* in Asia, called the Caspian *Sea*. A small quantity of standing water, you know, is not called a lake, but a pond, or pool. Where land and water are intermixed, so as to make the earth soft and yielding, it is called a *morass, marsh, or bog, a fen, or swamp;* nay, if you do not like any of those terms, you may call it a *quagmire;* but that is perhaps more properly a bog, which shakes or quakes under your feet.

A large stream of fresh water, running towards the sea, is a *river*. A small stream is a *rivulet* or *brook*. When a stream rushes on with great fury it is called a *torrent*. When a river runs over a steep place it is called a *cataract*, or waterfall; if a little one, a *cascade*. Where the sea runs partly up a river, it is sometimes called an *estuary*, or in Scotland

a *frith.* So much for the water, now for the land.

A great extent of country, undivided by seas, is a *continent*, as Europe. A piece of land, or a country entirely surrounded by sea is an *island*, as Great Britain. A very small island is called an *islet.* A country nearly, but not quite surrounded by water is a *peninsula;* and the neck of land which joins a peninsula to the continent is an *isthmus*, as the isthmus of Suez and that of Darien. Although Africa and South America, because of their great extent, are called continents, each of them, in point of shape, is a peninsula. When the land is high, and projects far into the sea, it is a *promontory;* a smaller projection is a *cape.*

I suppose you know, that when the earth

seems to be raised in a heap it is called a *hill;* if very high, a *mountain;* and if mountains are in a row, or pretty close together, they are *a chain* of mountains, as the Appennines, in Italy. A mountain which sends forth flames is a *volcano;* as Etna, and Vesuvius.

And now let us cast a look behind, to remind us of what we have been attending to. We have seen that the planets move round the sun, and that the earth is one of those planets, and that those planets, with the sun, are a separate cluster of worlds, called the solar system. We said a word or two respecting the prodigious size of the earth, and have shown that it has nothing, and needs nothing on which to rest for support. Thus we examined the *artificial globe*, and paid some attention, at least *I* did, to the lines and apparatus connected with it. If you took the

trouble to perform the little experiment with the lighted candle and the orange, you will remember how the coldness of the polar regions, and the alternate long day and long night were thereby accounted for. Then, you know, we came back to the earth again, and observed that it was of the same shape as that which is made to represent it; that it has the same forms of land and water upon its surface, which consists of oceans, seas, gulfs, bays, creeks, straits, lakes, rivers, and pools; also of continents, islands, peninsulas, isthmuses, promontories, capes, hills, and mountains, some of which are volcanoes. So much then for the globe and the great features of its surface. Let us now see what are *the materials* of which its solids and fluids—the substances that is, of which we have any knowledge—are composed.

Now it used to be the custom to divide these into four grand compartments, known to old-fashioned philosophers, and our grandmothers, as fire, air, earth, and water—called the four elements. But we moderns are not satisfied with this arrangement of things; because fire, air, earth, and water are, in nature, all more or less *mixed together*, so that we cannot in fact tell which is the simple or *elemental* substance. In larger works of science, therefore, we hear little of these four elements as such, but bodies are treated of under other names. For our present purpose, however, nothing can be better than those old household words, which seem to take hold of the great book of nature by its obvious four corners; and I think, if we do not run into the error of calling them *elements*, we shall do well to speak separately of fire, air, earth, and water still. These are the things amongst

which, under the direction of the Creator, we live, and move, and have our being, and are therefore constantly present to our senses, and have properties and operations of the most interesting kind; but perceived only by those by whom they are "sought out," and who have "pleasure therein." In our enquiries respecting the nature and operations of the things around us, we shall gain, I trust, a little acquaintance with what is commonly called natural philosophy. Let us see now what sort of a business we can make of it.

I think I ought to mention, first, that every substance in nature which has *parts*, and is of a kind to be discerned by the bodily powers, is called by the general name of *matter;* whether the thing in question be heavy and hard, as *iron*, or thin and invisible, as *air;* or even if it be entirely *without weight*, as *light*,

it is something which still goes by the name of *matter*, and is therefore said to be *material* in its substance. What can be more different, apparently, than a *bar of iron*, and a beam or ray from the pale moon? Yet each is composed of *particles*, which, in many respects, have similar qualities. A piece of iron thrown against a wall will rebound from it—so will *light*. If a ball of iron be thrown against a wall in a particular angle, or direction, it will fly off from it in a corresponding opposite direction—light will do exactly the same. It is therefore a *substance;* and like iron, or any solid body, shows that it is a *material* substance when it comes in contact with other substances. If you were to think about this more than I am afraid you will, you might be ready to ask, what then is there which is *not* matter? I will tell you what. It is that which, before you speak, frames the question; it is *your mind*—YOUR SOUL! Now fix your

eyes upon any object you please; a tree, for instance. Very well, there is the tree; that is a *material* thing. But again, shut your eyes, and *think* about the tree: imagine the stem, and the branches, and the leaves. That image, which you are then conscious of, your eyes being shut, must be, I conceive, an *immaterial* thing. Ideas, thoughts, and the power of thinking, therefore, are things which we do *not* mean, (at least *I* do not,) in speaking of *matter*. Now we are ready for fire, air, earth, and water.

It requires but a very little consideration to prove that each of these four is absolutely needful to the existence of living creatures. If the earth had been an *uninhabited* planet, then indeed it would not have required the variety of substances which are now found upon it. It might have been a frozen ball, or

a red-hot one; its surface might have been all water, or all land, and an atmosphere would have been as useless an addition as the tail of a comet. The different materials of which the world consists were evidently designed, and admirably and beautifully adapted they are to the innumerable wants of creatures.

The first thing that strikes us is the loose and pulverized state of the soil, or surface of the ground. Suppose, for instance, that this had been otherwise, and that instead of the fine rich black mould, the clay, the loam, the sand, and other soft and obedient earths, which are already prepared for the use of man, the land had been uniformly hard and solid in its texture. Again, if there had been earth, but no water; seas, but no springs, or rivers; or had there been water, but no air; or earth, air, and water, but no fire or heat;

if, in fact, we had not been supplied with these things, and if they had not been fitted for our use by the express design of the Almighty; if there had been any thing like *chance* in the formation of them, creatures could not have been continued in existence as at present. We shall see this more clearly, now that we are to attend separately to the things just mentioned. I shall begin with *earth*.

I have already remarked, that the external surface of our planet, forming the ground, or soil upon which we tread, consists of different kinds of loose earth, fitted for the various wants of men and animals. If we take up a handful of fine garden-earth, and examine it attentively, we shall, in general, find that it is composed partly of very small fragments of stone, and partly of decayed animal and vege-

table substances, and the more of this there is in earth the greater is its fertility. The earths commonly met with are *black* earth, which we have mentioned, *clay*, *sand*, *marle*, *chalk*, and *stony earth*.

Some thoughtless persons might be apt to wonder that Providence has not covered the land completely with the earth which is the most fruitful. It is true, that clay, chalk, sand, and stone, are substances in which scarcely any eatable vegetables will grow; but what then? A man in civilized life wishes not merely for food to eat, but for a *dish to eat it in*; aye, and for a house to sit in, whilst he is at dinner. Now, the cleverest fellow in the world could not make a dish, or a *brick*, of garden mould. You see, therefore, that without the materials from which the conveniences of life are produced, man must have remained

to this day in a savage and barbarous condition. There is nothing which strikes us more forcibly in surveying nature, than the infinite variety of substances of which the surface of the earth is composed—made, and designed, and placed *near* the surface by the bountiful and careful hand of the Creator, expressly for his use and benefit. Here again we see what wild work *chance* would have made in the construction of a world for the residence of man. If the materials of which the earth is composed had been confusedly jumbled together, how could we have obtained them? If *iron*, for instance, of which we shall shortly have to speak, had been five miles *deep* in the earth, none would have been known to exist; and *without* it, it is a question whether civilization would have proceeded at all. This is certain, that in those parts of the world where iron is unknown, the

natives are unacquainted with the arts of life, and are *savages*. If a man is obliged to use a fish-bone for a spear-head, and a sharp stone for an axe, it matters not that the soil is fertile beyond his occasions, and that he has gold, silver, and diamonds in abundance: he is, if denied that inestimable metal, unable to employ his hands or his head as a workman or an artist; he can form no implements, and without implements he can execute no undertaking beyond that of just providing himself food, covering, and shelter.

This leads us to take more particular notice of the substances called metals, of which the earth is the grand store-house.

The metals with which we are most familiar are gold, silver, copper, iron, lead, tin, and mercury or quicksilver. There are others well known to chemists, and which are not of

a kind to be useful for general purposes, as platina, antimony, bismuth, zinc, cobalt, arsenic, &c. These last are chiefly of service as drugs for medicine, or the arts.

Gold is usually placed first in the list of metals, and has by almost all nations, in all ages, been considered the most valuable of them all. It is difficult to find a sufficient reason for this preference. Gold is, as we know, not by any means the most *useful* of them; nevertheless, it has some peculiar properties, which perhaps, with its beautiful colour, have contributed to raise its value. It is the most *ductile* of all metals, and of all substances whatever; that is, the most pliant, flexible, and capable of being drawn out, or spread out without breaking. Now remember what I am about to tell you:—a single pound of gold may be drawn into a wire long enough to go round the globe! It may be hammered

into leaves that are forty times thinner than common writing paper. You see, therefore, of what astonishingly fine particles gold consists. This quality of extreme *ductility* makes it possible to gild a very large surface with a very little gold. Articles that are thus covered, as picture-frames and watch-cases, have the rich and splendid hue of gold itself, and that with comparatively trifling cost. Another valuable quality of gold is, that it does not *rust*. You know, a piece of iron, or steel, however brightly polished, if exposed for any length of time to damp air, will become red and rough, and in time would be almost consumed by the mere effect of moisture; but a gold wire, thinner than a hair, would remain uninjured in any climate.

Gold is found chiefly in countries which lie between the tropics. In Africa, towards the

equator, it is found in small grains, mixed with the sand of rivers. They take a quantity of this sand and mix it with water, when the gold, by its own weight, sinks to the bottom; thus, by repeated cleansings, they get rid of the sand entirely. But gold, like other metals, is, in general, procured from deep pits, or rather caverns, dug in the earth, called *mines*. You must not, however, suppose that the miners find it in bars, or in lumps, all bright and shining, ready to their hand. The substance from which it is procured is called *ore*, and so little does it resemble the metal it contains, that if you were to dig in your garden and find a gold-mine, that is, a mine of gold ore, I am sure you would not guess, from its appearance, that you had found a treasure. Ore, in general, is a dark-looking, stony sort of a thing, rough, shapeless, and heavy, according to the metal which is in it. The ore is

put into furnaces, and after a vast deal of trouble they succeed in obtaining from a great quantity of ore a small quantity of gold. But the trouble does not end there. Gold, when produced pure from the ore, or as nearly pure as they can get it, is so *soft* as to be unfit even to make money of; it must therefore be mixed with another metal, (usually copper,) to make it fit to be handled. This added substance is called *alloy*. Gold is heavier than any other metal but *platina*, which is not often to be met with, as it is procured only in very small quantities, and for particular purposes.

What has been said of gold may be said of silver, nearly; it is beautifully white, and takes a fine polish. Silver, as well as gold, is not liable to rust from the air, and may, by its *ductility* be extended in wonderfully fine leaves and wires; but not to the same degree

as gold. It is heavier than iron or copper, but not so heavy as lead. When the Spaniards took possession of the various provinces in America, they had the fortune to discover the richest gold and silver mines in the world. The quantity of silver obtained by them from Mexico and Peru has been prodigious. I said that metals are usually found in a state of ore; but in some mountains of the New World, silver is so abundant as to lie in veins, like the roots of trees, solid, and nearly pure. It is said, that a famous silver-mine was once accidentally found out by a man climbing the steep side of a rugged mountain, in doing which he stumbled, and catching hold of a bush, his weight tore it from the roots, when he perceived something white underneath: this proved to be a heavy piece of actual silver! But the riches thus obtained by Spain have done that country more harm

than good, and have gradually debased the ancient character of the nation, by rendering them luxurious and indolent. A bag of money would be a bag of mischief to all those who know not the right use of it.

And now, what a different substance from silver and gold, is *lead;* and yet it resembles them in some particulars, which render it very useful, especially as it is procured in great abundance. Lead, like the metals just mentioned, is not liable to rust or decay, when exposed to the weather, or in so trifling a degree, that it is almost as good in that respect as gold. It would, you know, cost rather too much to make water-pipes, and cover roofs of houses with *gold and silver!* A roof, overlaid with gold, it is true, would keep the rain out uncommonly well, and would last long enough; but then, it might

make a rich man poor to supply a single square yard of it! And so, what does he do? Why he takes a few small pieces of his gold and exchanges them for as much dingy, homely, but useful *lead* as will cover his house, resist the wet, and remain uninjured by its effects.

Lead being easily melted, is easily worked and wrought into flat surfaces, called sheet-lead; and is cast, without trouble, into pipes and other forms. It is nearly as heavy as gold, and is therefore very useful for weights of clocks, where there is not room for any thing large or clumsy. Little boys, I suppose, need not be told how easily lead may be melted at a common fire and cast into any figure, by means of a mould. This metal, though useful, is poisonous, particularly preparations of it, called white-lead and red-lead:

white-lead is the principal ingredient in white paint. The article called *black*-lead, of which pencils are made, is, in fact, not lead at all, but a mixture of iron and other matter—chemists call it *plumbago*.

Copper resembles gold a little in colour and in ductility, but in nothing else; it is easily *tarnished*, or discoloured, and if polished ever so well, soon becomes green and foul by exposure to the air. The green rust of copper is called *verdigris*, and is a most deadly poison. Copper has many useful qualities: it is much lighter than lead, and as it rusts but slowly, and only the surface, it is sometimes used for roofing buildings; but it is much more expensive. It is harder and more *ductile* than lead: it may be hammered into plates of almost any shape; but this property of enduring the hammer, without

breaking, is termed *malleability; ductility* is the quality of being *drawn* out without blows. A piece of copper, the size of a half-penny, may be beaten almost into the shape of a hollow globe: this capability makes copper particularly useful for vessels of difficult forms.

Copper has long been used in the arts for the purposes of engraving. You know, I suppose, that the prints put in frames and inserted in books are not *drawn* upon the paper; they are engraved upon metal plates. Afterwards these plates are rubbed all over with a kind of oily ink like black paint; when this is wiped off the surface, there is still a quantity remaining in the engraved parts; the paper, therefore, is laid over the plate, and both together are rolled through a very tight press. The paper is then taken off, and there is your

print. Thousands of prints may be taken from one engraved plate; by which means, you see, books with prints may be had for comparatively little money. Steel plates are now very frequently used.

But there is another use to which this metal is applied, that we must not forget; little articles are made with it, as with gold and silver, which, like "Aladdin's Wonderful Lamp," are the most convenient things in the world for procuring us what we wish for—you know that I mean *money*. These metals being so different in value, serve admirably well for various sums of money. Gold would not do to make shillings of, nor silver to make pence; for a shilling's-worth of gold, and a penny-worth of silver would be no bigger than a spangle. Again, copper would not do to make shillings and guineas—a copper shilling

would be as big as a snuff-box, and a copper guinea would be like a Derby cheese in a man's pocket! The reason then is evident why small sums are made of cheap metal, and larger sums of that which is more expensive.

Iron, as I have before hinted, is the most decidedly useful of all metals: it has not, indeed, the beauty of colour, nor the fineness of quality which gold and silver have, and it is, more than any metal, subject to injury from rust. Large rods of iron are sometimes eaten completely through by the action of air and moisture, as you may see in old church windows, in which the bars, towards the bottom, have dwindled to a size scarcely thicker than a pin; this, however, is not always the case, and there are iron bars in ancient buildings, which, though red and rusty, are by no means consumed.

To prove the usefulness of iron, let us think a little. It is cold weather, and I will suppose you sitting by the fire-side, in a comfortable room containing the usual articles of furniture. Now we will take them one by one, and *send every thing away* which could not have been procured if there had been no *iron* in the world. *The fire-place.*—Here are, a cast-iron stove-grate, iron instruments for stirring the fire, (for steel is iron hardened;) then there is a brass, or steel fender, a marble chimney-piece, and a chimney-glass above it: *all* these must be dispensed with. "But, perhaps," you say, "we can have a stove made of *copper*, or *brass;* and as for the fender, that *is* brass, so we may certainly keep that; and I am sure that the marble chimney-piece and the looking-glass, *they* are not made of iron, so you shall not move *them*, sir."

"But indeed I must, sir." Let us see: *marble* is split off the quarry by *iron* instruments; it is raised in huge blocks, from thence, by the help of *iron* engines; it is conveyed either in ships or carriages, which, without *iron*, would drop to pieces; it is then sawn with an *iron* saw; it is chisseled and fitted with an *iron* tool! And now, where would your marble chimney-piece have been without iron? Why, in the quarry. No metal *but* iron would have been competent to obtain it.

The same may be said of the looking-glass; which, although not made of iron, is constructed by the help of instruments which, in a multitude of instances that would be tedious to mention, are employed in its formation. Besides, the mineral substances of which glass itself is made, as well as the

quicksilver behind it, were locked up in the bowels of the earth originally, and nothing but hard iron was used to dig them out.

Your iron stove, you say, might be replaced by some other metal; but, you see, other metals could not be obtained without the help of our constant friend, *iron;* which being found in quantities, almost, or quite at the surface of the ground, comes easily and needfully to hand, for working mines of all depths. Without iron I am afraid you could have no stove at all; but must make a fire as the savages do—on the bare earth.

After this you will not be surprised to learn, that the chair you sit in, the table you dine upon, the carpet, nay, the boards of the floor; aye, and the walls and ceiling of the room, and the house itself, were each

made and formed by the incessant aid of iron, either as tools or materials, without which they could not have been produced; so that, unless you will consent to be indebted to hard and homely *iron*, you must really turn out, and live in a wood, like a New Zealander, or an Indian.

The grand difference between iron and all other metals is its superior hardness; and it is capable, by a particular process, of being made into steel, which is so extremely hard that it can cut almost any substance in nature but the diamond. Copper, which is the hardest metal next to iron, would not form an edge for a tool that would last even for cutting wood. A silver knife will not cut *meat*, and is therefore furnished with an edge of steel, to make it serviceable at table.

But there is a quality, yet unmentioned, belonging to iron, called *magnetism*, which is indeed a most admirable and unaccountable property. A slender piece of iron, no bigger than a needle, when touched by the *magnet*, or *loadstone*, acquires the power of turning itself, when properly balanced, so as to point out the *north* and *south* in all parts of the world. By the direction of this mysterious guide, mariners can steer their course with certainty to any point of the globe. Before the mariner's compass was possessed, the stars, or the shore, were the only trust of the pilot; and if these were hidden, his utmost skill in navigating his vessel availed him nothing. Most amusing experiments may be performed with a common magnet, and a paper with iron-filings sprinkled over it, which, as the magnet is moved beneath, will assume the most beautiful feathery forms.

I am not sure that we ought to call magnetic attraction more wonderful than the attraction of gravity: it excites our attention more, because it chiefly belongs to iron and the loadstone, but the attraction of gravity is common to all bodies with which we are acquainted. Both, however, are far beyond the reach of human reason: we can observe the effects of each, but we know nothing of the cause;—this, however, has been stated before.

We must add to all the valuable qualities of iron that have been mentioned, this also, that it is of the utmost use as a medicine. Whilst metals in general are more or less poisonous, iron, that is, a preparation of it, in powder or liquids, is the finest restorative in nature in certain cases. There are, in various parts of the world, and in England,

medicinal springs, which derive their virtues and their name, *(chalybeate waters,)* from the iron contained in them. *Chalybs*, is the Latin for hard iron, or steel. You see now, I hope, that iron is a more valuable metal, strictly speaking, than silver or gold. Being, however, very *abundant*, it is low in price; it is well indeed that it is so. It is a fact worth remembering, that some of the American Indians, who from Europeans have found out its use, will exchange, for very small pieces of iron, great lumps of gold with the utmost eagerness. With them, you see, the case is reversed—they have plenty of gold, but no iron of their own; iron with them is the precious metal.

How carefully, then, has God provided for men, in furnishing such plentiful materials on which to exercise their mental and bodily

powers! Extensively useful as iron is, there are purposes, as we have seen, for which other metals are wanted; others are therefore supplied to suit all occasions which men may have, or think they have. We have now taken notice of gold, silver, lead, copper, and iron; but there are two others very distinct from these, and from each other, namely, *tin* and *mercury*.

Tin is found in immense quantities in Cornwall, and but little is met with in other countries. It is the lightest of all the metals, and is very easily melted; it is too soft to be used by itself for utensils, but being wholesome and white, is employed to advantage in covering other metals. The articles, therefore, commonly called *tin*, as tin tea-kettles and saucepans, are iron, covered with this metal, and are not in substance

made of it. Iron is, as we have said, innocent or beneficial, taken internally; however, it is not quite so good to look at, and being so apt to rust, the thin iron plates, of which vessels for the kitchen are made, are therefore always tinned before they are put together. Copper and brass vessels would be dreadfully dangerous, if not perfectly overspread in the same way with tin. Tinned tacks, are iron ones, put into a pan with melted tin, and thus they become entirely whitened with it. Tin is the most easily melted of all metals, excepting

Mercury, or *quicksilver*, which is never solid but during an intense degree of cold. It has, you know, the appearance of melted lead, and runs about so unmanageably, when spilt, that it is almost impossible to gather it up again. Its chief use is covering the backs of looking-glasses, preparing silver ore, and

in medicine. Without this, glasses would reflect but a very indistinct and shadowy image, but, by its assistance, the reflection is nearly as conspicuous as the object itself. It is this metal also which is enclosed in the tubes of barometers, and adjusting itself up and down, according to the weight of the air, it informs us whether the water floating above in the clouds is likely to descend or not. A preparation of quicksilver is much used as a medicine.

Do you think I have now spoken of all the metals, or are you wondering that I have not described *brass*, bronze, bell-metal, and pewter? I should certainly have reckoned them with the others, if, like them, they had been found in natural mines; but this is not the case. Brass is a mixture of copper and zinc, and is harder, when so combined, than

either of those metals separate. Bronze and bell-metal are composed of copper and other metals in various proportions. Pewter is a mixture of tin and lead.

There are many other substances dug out of mines, which are called *minerals,* as sulphur, salt, and coal. Properly speaking, whatever is obtained from a *mine* is a *mineral;* but that word is commonly applied by way of distinction to all the substances procured from mines, *excepting* metals.

Places from which solid stone is obtained are called *quarries.* All the flat stone which is used for building, for paving, for tombs, and other purposes; all the marble used for sculpture, or in houses, was taken from solid rocks of the same kind: it is sawn into pieces, not without much time and labour. You

have seen the men sitting in stone-masons' yards, slowly moving backwards and forwards the large wooden frames in which their saws are fixed: these saws have no teeth, they are used with sand and water, and therefore rather grind than cut.

The substances called *precious stones* seem to derive their value entirely from the estimation in which the *fancy* of mankind has held them. The diamond being the hardest production of nature, is occasionally used by artificers, it is true; but it is not upon this account that it is so highly prized—it is its transcendant brilliancy, when polished, that is its grand recommendation, and in this respect it far excels all other jewels. Another thing which makes precious stones so very costly, is their great scarcity: they are only found in a few places, in small quantities, and so small

in size, that there is not, I believe, more than one diamond as big as a hen's egg, known to exist in the world: had there been as many diamonds as there are gravel-stones, not all their internal lustre would have induced men to take the trouble of polishing them.

I have now taken a little notice of the most important substances furnished by *earth* for the use of man, the chief of which are the different soils, metals, minerals, and stone, or stones. We must next take a view of some of the most remarkable forms and appearances which the structure of the earth, in particular places, presents to our attention.

FORMS OF THE EARTH'S SURFACE.

The external surface of the earth, as we have seen, consists *generally* of mould, or soils of different kinds. It is by no means the fact, however, that every part of this surface is favoured with a supply of *earths* needful for animal and vegetable life. The arctic, or polar regions, are denied almost every advantage of this sort. Bleak and rocky mountains and hills, frozen fields of snow and ice, complete, as we are aware, the rude landscape in those inhospitable regions. But how is it

between the tropics and under the equator? A very large portion of Africa is like nothing so much as a boundless sea of burning sand! Tracts of land of prodigious extent are there composed, not of earth or clay, moistened, as in England, with waters from showers and springs; but of dry, dusty, and dazzling sand, heated so constantly by the rays of the sun, as to scorch and blister, in the most dreadful degree, the feet of the wretched travellers in those fierce deserts. Day after day they may journey on, and not a single object meets the eye but the same uniform sand: the scorched desert can produce no tree, no herb, and therefore no shade is to be obtained—no cheerful green relieves the sight.

Now which do you prefer? The sandy deserts of the tropics, or the frozen, snowy, and rugged regions near the pole? Doubtless

the latter are more tolerable, because they admit of a remedy. Fire, you know, can be made to burn as well in a hard frost as at any time, and by means of this the Greenlander can make himself warm in his cabin. But though they can lessen the cold of the north, there is no way of lessening the heat of the south: all that can be done is to submit to it patiently.

Other parts of the earth, too, besides those in extremes of heat and cold, are rocky, barren, and rugged; and there are, even in England, tracts of considerable extent which are of this sort. Cornwall is greatly so; but there the treasures of metallic ores beneath the soil, form the riches of the country. In general, however, those countries which lie in the temperate zones, and some also in the torrid, abound with rich earth, which is co-

vered with a green coat of vegetation. But there are pathless forests, the ancient and undisturbed possessions of ferocious beasts, and venomous and deadly reptiles; so that even amid the fields and forests which, compared with deserts, are the garden of nature, it is needful to look out and choose, before we find one suited, in all respects, for the necessities and conveniences of civilized men.

The earth is of a size sufficient to allow a choice of situation; but it is seldom the case that the natives of any country, however severe the climate and barren the soil, are discontented with it. The Laplander would not give up his snowy domain, nor the wild Arab his parching sands, for the most delicious gardens of France or Italy. Englishmen then have little cause to envy the lot of other na-

tions, or to be discontented with their own. Placed in the temperate regions, the breath of heaven is here ever comparatively mild; the soil is verdant and fruitful to abundance; the bowels of the earth in this country are rich in metallic treasures; its seas and rivers yield boundless supplies of fish; and whilst its woods and forests afford luxurious viands to the tables of the wealthy, in the varieties of game; the broad, spreading pastures, the furrowed hills and valleys, produce cattle and corn (the more substantial blessings of the soil) in plentiful succession.

The general surface of the globe, therefore, displays no uniform appearance, but the utmost variety, according to the climate and the nature of the soil. We must now take a little notice of those particular objects of attention, above and under the surface, which exist in

different countries. The earth, you know, is neither level and flat on the outside, nor entirely solid and free from hollows within; it has *mountains* and *caverns*.

A *hill* is a *gentle* rising of the ground, a roundish eminence, sloping moderately each way; but a mountain is like a prodigious pile of earth and rocks, reared up to a height of which those cannot conceive who have never seen one; often piercing the clouds, and in some instances having their summits one or two miles above the highest clouds that rise!

Caverns are of various dimensions; and some are not larger than a common room. But there are others of such surprising extent, that the largest cathedral in the world would be like a mere play-thing within them.

There are caverns, made by *art* and human labour, of astonishing magnitude. The stone-quarry at Maestricht is so large, that forty thousand persons may be contained in it; and it serves as a place of shelter, when armies pass that way, being a fortress the most secure that ever was constructed. Nothing is more beautiful than this cavern, when lighted up with torches. There are thousands of square pillars regularly carved, twenty feet high, which support the roof; all is dry and comfortable—no damps or drops are seen on the walls, nor is there the least danger even in dwelling there, if persons should take an early fancy to a subterranean abode. Spain has a great number of artificial caverns, which were made to serve as places of refuge to the persecuted Christians, when the Moors conquered that country. But it is works of nature, and not those of art, that we are at present concerned with.

I shall now give a short description of one or two very remarkable natural caverns, which will give some idea of the others. Some of the largest and most beautiful in the world are found in Britain.

That surprising cavern, or grotto, called Oakley Hole, is near the Mendip Hills, within a mile of the town of Wells. You must bear in mind that a cavern is a kind of roomy, open place, *underground.* Oakley Hole is a prodigious hollow in the side of a mountain; but which is closed up excepting a very narrow entrance. You go in, winding along upon an uneven sort of pavement; as you get further in, the roof, or top of the cavern grows higher, till it is fifty feet from the floor, and then the cavern is found to be six hundred feet in length. But the chief beauty of this and other caves of the same kind is, that the roof is covered with the most

splendidly brilliant spars and crystals, which hang in a multitude of fantastic figures: these, when lighted torches are brought in, sparkle and glitter in so magnificent a way, that it seems as if the place were illuminated by ten thousand chandeliers, and, indeed, reminds one of those fairy palaces described in Eastern tales. At the farthest end of this superb temple of nature, issues a stream of water well stored with fish, and large enough to turn a mill.

I suppose, now, that if St. Paul's cathedral were ornamented within by millions of diamonds and polished jewels, and then were to be illuminated by innumerable lamps and candles, it would give some idea of these underground recesses.

Fingal's Cave, in the Hebrides, is said by

far to exceed Oakley Hole ; but I believe the most remarkable in the world is the cavern or grotto of Antiparos, an island in the Grecian Archipelago. I will present you with the account of it, given by a traveller who visited it about a hundred and fifty years ago.

He was informed, that at the mouth of a dark cave in this island, there was just to be seen, by those who would take the trouble to go and look, the statue or figure of a giant, which frightened some of the good people thereabouts not a little; so he and his friend thought they had a right to be frightened too, if they pleased, and they determined to pay it a visit. After walking three or four miles they came to a hill, in the side of which was a most ugly hole, which yawned upon them horribly, like the great mouth of some hideous being. However, they took courage, and

marched boldly into the darksome gulf, and had not proceeded above twenty steps, when the supposed giant was dimly seen in the midst of his gloomy cave. What was to be done? Were they to walk in and walk up to him, to see and know, to speak to him and to touch him? or were they to slink away, and return no wiser than they came? Youthful reader, which wouldst *thou* have done? Our travellers had courage and curiosity enough to lead them on. They approached, and on holding a torch up to the figure, perceived that it was nothing more nor less than a long and large assemblage of glittering spars and crystals, which hung like a body of icicles from the roof of the cave. I should observe here that these beautiful spars, and such as are placed as ornaments over fire-places, are formed by the continual oozing out and dropping of water through the crevices of the rock; and

this water is of such a nature as to form into a shining, stony substance, as it descends.

In this way the sides and roofs of most caverns are richly garnished with sparkling gems; and these, when a light is introduced, have a more splendid appearance than can possibly be imagined by those who have not witnessed them.

As the persons who had entered the grotto of Antiparos proceeded, new wonders met their eyes: the spars, formed into shapes resembling trees and shrubs, seemed like a petrified grove, being of various colours and sizes, like the plantations in a garden. But as yet they were but in the entrance to the vast temple of darkness which lay beyond: they perceived an opening in one corner, about three feet wide, which seemed to lead

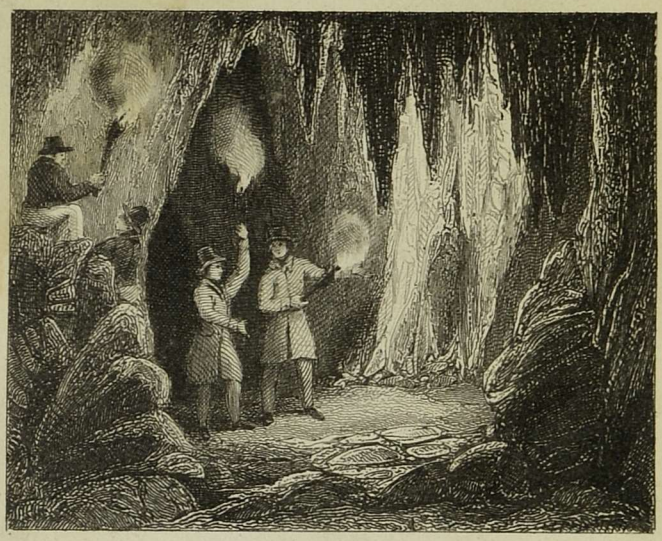
to a place absolutely dark and invisible; into this they threw stones, in order to know, by the sound, whether it had earth or water at the bottom, or whether it had any bottom at all. By the hollow, rumbling noise, followed by a splash, they judged that there was a rocky descent, leading to a lake beneath; they therefore returned to procure more torches and a ladder: they then entered, and went down about fifty steps, and found themselves in a cavern of inconceivable magnificence and grandeur—the lofty roof and far-receding walls were almost too distant to be discerned by the eye; but every part of them was studded with spars, transparent and polished as glass, yet hard and solid as marble; each of these reflecting a beam of light from their torches gave the appearance of a temple actually illuminated with myriads of them at once. The floor was beautiful marble; stu-

pendous columns arose from it to the roof, whilst masses of the same substance which stood around, gave the idea of thrones, altars, and statues to complete the same.

Beyond this cavern was still another, which was not completely explored. They had seen enough to show them how infinitely these hidden works of nature transcend and exceed the most laboured productions of man.* Our account of it is taken from that of a traveller, who, it is said, was the first that ever entered it.

So much for caverns. They are chiefly found in mountainous countries, and amongst rocky and rugged places, in which, besides

* The Grotto of Antiparos is said to have been discovered by Kircher; but has been subsequently described by Tournefort.



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Grotto of Antiparos.

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Volcanoes.

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these subterranean chambers, which spread in a level direction, there are often seen tremendously deep cracks or gaps in the earth, more properly called *fissures:* there are openings of this kind, the depth of which it is impossible to know, for they descend beyond the reach of ropes and lines; and stones thrown in, seem to find no bottom, but rattle against the sides, and still proceed, till the sound is lost in the abyss!

We will now leave these gloomy gulfs, and rise above-ground to observe what forms the earth takes externally, which may be worth observing. The most remarkable of these are *mountains*, some of which send forth flames and smoke: these are called *volcanoes.*

As I said before, those who have never

seen any thing larger than a *hill*, cannot conceive of a mountain. A hill, in general, is not at all the same *kind* of thing as a mountain. It is not, merely, that one is a *little* heap, and the other a *great* one; but the two are formed, for the most part, of very different materials, and are altogether different in figure. Suppose now you were to take several bushels of sand, or earth, and were to throw them together in one place, the whole would take the shape of *a hill:* it would be a *roundish* sort of a heap. But if there were a quantity of logs and lumps of wood and stone, pieces of a broken wall, lumps of hard or frozen earth, with some loose earth amongst it; then, perhaps, if it were shot suddenly down, the heap would be more like a mountain than the other, at least in form.

It would be useless, in this place, to describe minutely even the principal moun-

tains of the world. In Europe the Alps, in Asia those of Nepaul and Thibet, in Africa the Mountains of the Moon, and in America the Andes, are the highest elevations on the globe.

WATER.

THERE is a reason and a design, viewed with perfect clearness by the Creator, but which will probably continue nearly hidden from man, with regard to this great fact in nature—that water occupies considerably more of the globe's surface than land. But we are far short of truth, in supposing that the oceans and seas, the lakes and rivers, with the various forms of inland water, comprise the whole domain of this unmeasured fluid empire. The air, the earth, and nearly every known substance, contains it *invisibly;* whilst

visibly it puts on the varied guise of rugged cliffs, as in the frozen crags of the northern seas; of thickening shadowy robes, as in the air-borne clouds; of glistening jewels in the early dew, and of almost viewless wreaths in the vapours which lie on the surface of the plain.

The first thing to be observed with regard to the great mass of waters—the ocean, is its *saltness*. Men have puzzled their heads, up to the present time, in vain, to discover the cause and design of this one ingredient being found, to so vast an extent, mixed up in nature's grand reservoir of fluids. Some have thought that there must be mountains, plains, nay, continents, of salt at the bottom of the sea, to impart that quality; and others have supposed that the *intention* was thereby to keep the great mass of waters from corruption. Let

these things be as they may, the fact is, that the ocean, which contains not less than twenty-one millions of cubic miles of water, is every where *salt;* and so much so, that many tons weight of that commodity are obtained from pits a few yards square, in which the water of the sea is evaporated for that purpose. Inland lakes also, when shut out from the sea, are frequently salt, but not those which have rivers running through them.

And now let us look at the ocean, as it lies abroad, amongst and between the various portions of land, and endeavour to find out some of the reasons and advantages of its being thus disposed. In the first place then, it is absolutely needful for the continuance of animal and vegetable life, that a copious supply of fluid, or water, should constantly be afforded. Water, in fact, is the fountain of

subsistence to every thing that lives. Well then, if the vast continents are to be occupied with animated beings, in what manner, and from what stores, are the enormous wants of these innumerable millions of thirsty things to be provided for? Lakes and rivers do much; but, alas for us, if vegetation were confined to the margins of those places! No: the blessing must descend in expanded fulness from above; and to this end, the watery stores must be obtained from an adequate reserve for vast occasions: they must be uplifted by the mechanism of heat to evaporate, and an airy vehicle must support them; winds must waft them from land to land, and the appointed changes in the buoyancy of the air are required to sustain, or to let down, the genial drops in season. Such is the case, and perhaps the prodigious ocean is not larger than is needful to supply that immense treasury of the clouds,

whereby the surface of the four continents is to be in turn visited and supplied. But I intended rather to treat of this subject when speaking of the *operations* of nature.

But the convenience of man, not less than his necessities, renders the intervention of frequent tracts of water beneficial; and we know that the great distinction between civilized and savage nations has been made by mankind, when they have aimed at something more than the supply of their first and simplest wants. That which is not found in one country is produced in another, and a very advantageous intercourse, in the way of exchange, goes forward, provided the sea forms a medium of conveyance. It is easy to see, that mahogany and tea, and the multitude of our common articles of use, would never have been in England: nor would our own manu-

factures ever have reached, in turn, the countries whence those former commodities come, had it not been for the heaving bosom of the buoyant wave, which sustains the precious load, and bears respective products from shore to shore.

Water, like iron and other substances, remains in a solid state, until heat comes, and interposing between the particles, of which the ice is composed, sets them at liberty as regards each other. It is well, indeed, for us, that ice is sooner melted than some other things, or we must either eat it whole, or drink it scalding hot. No substances are so active as fluids in obeying the law of gravitation; they seek and find their level on all occasions: and thus it is that water, dashed from the clouds on the brows of the mountain crags, descends the sides with eager haste, and find-

ing the lowest parts of the plain beneath, pursues its winding way in the form of rivers, and at length discharges into its original source and treasury—the sea.

Water, pliable and flowing as it is, when at liberty, occupies its place like a lump of iron when confined. Nothing is easier than to dip your finger into a cup of water—the fluid gives way with scarcely any perceptible resistance; but if the fluid were enclosed in an iron vessel having a narrow aperture, and then an iron plug were introduced, fitting so well as to allow no escape at the sides, it would, on touching the water, encounter a hard and resisting body, which no force could sensibly compress.

But its own weight gives water the power of sustaining vast burthens on its surface.

The foundations of solid buildings often sink into the earth, and in some cases entirely disappear; whilst the most ponderous fabrics of shipping are supported by the wave, unless the fluid itself enters as a burthen and sinks the whole. The reason is, every substance which floats, displaces as much water as is exactly equal to its own weight. When a log of wood, for instance, is placed in water, that part of the wood which is below the level of the stream, weighs exactly as much as the water which would fill up the place if the wood were not there.

I have said, that water is the fountain of subsistence to every thing which has life. Its first change of substance, for our benefit, is through the pores of vegetables into the varied materials of which their leaves, fruit, and body are composed. Many plants will grow in mere water; but none in *mere* earth.

The necessary watery particles, however, are by no means supplied entirely by the earth to the root; the leaves imbibe them plentifully from the surrounding air, and thus a constant circulation for increase is carried on.

I need not say, that without water all animals would quickly perish. Do you reply to this, that sheep, and rabbits, and probably many other creatures, never drink? To this I answer, that the abundant juices of their food supply the needful moisture, and therefore they have no need to drink the water requisite for their health. Grass and herbs, or their food, of whatever kind, has water in its composition, and it suits them to take it thus without *additional* supplies in the fluid form. But I must now speak of another fluid, of which you and I swallow gallons in a minute, although it is a thing taken in an *unseen* form.

AIR.

I DARE say that water is as invisible to the finny inhabitants of the deep, as is the air to us. It is astonishing how apt we are to credit *our eyes* at all events, even though they often deceive us, whilst our other senses, which rarely, if ever, mock the truth, are scarcely believed on their evidence alone.

If we take a vessel of water, and discharge the contents, we say it is *empty*, merely because the fluid which immediately occupies the place of the water, is not to be discerned by the eye; whereas the *air*, though invisible,

fills the space even more completely than any other substance, and is capable of resisting the entrance of any other substance, when compressed to a certain degree.

The air is a thin, insinuating fluid, which surrounds the whole surface of the terraqueous globe, and is thought to extend to between forty and fifty miles in height; but this cannot be exactly determined. It has *weight*, and it is found that the pressure of the air upon the globe is equal to that of as much water as would be thirty-two feet every where in depth, and as much mercury as would be twenty-nine inches and a half. It is evident, therefore, that the gravitation of this unseen fluid is almost incalculably great upon the earth. In fact, it has been found that the weight of air sustained by a man of common size is not less than 40,000 pounds. This seems mar-

velous; but wondering, as some one says, is not the way to grow wise. The air presses *upwards* as well as downwards, and exists in the very composition of our flesh and bones. We will explain the thing thus: suppose a weight of ten pounds is placed upon my hand —I can sustain the pressure but a short time, unless I have assistance from below; if, therefore, I place my hand upon a table, which is able to resist that weight, I feel its tendency to depress my arm no longer. The thing has been proved in this way:—a vessel, like a drinking mug, with a rim to it, has a piece of wetted bladder stretched and tied firmly over the top, like a drum-head. Then, by a machine called an air-pump, the air is drawn from within: the consequence is, that the air above, pressing as before with a prodigious weight, forces the bladder in, now unsupported, and rends it with a loud report.

An easy experiment, to show the resisting power of air, may be performed with a pair of common bellows. Let one clasp the two handles together as tightly as he can, whilst another applies his lips to the nozzle, and blows in with all his force. It will be found that the power of the blower, if the bellows be good, will exceed that of the holder, who will be obliged to let the handles part, by reason of the force of the in-coming air.

A most surprising property of air is its elasticity, or power of occupying more or less space, according to the pressure to which it is subjected. A common bladder, blown pretty tight, will exemplify this, between the hands. But the most surprising specimen we have of the elasticity or spring of the air, is in the instrument called an air-gun. In this a copper ball, three or four inches in diameter,

has a pumping apparatus fastened to it, by which perhaps a hundred times the natural quantity of air is forced and detained therein. The effort made by the air thus confined, to escape, is so violent, that when an aperture is for an instant occasioned, the prisoned fluid, which issues, proceeds with such force and speed, as to propel a bullet through a board from the gun-barrel attached; and the reserved air will perform this operation thirty or forty times in succession, without fresh renewal.

In fact, a bullet from a common gun is forced out by nothing but a sudden rush of air, created by the exploded powder, and which, assuming and occupying a bulk some hundred times greater than the powder, makes itself room in the readiest possible way, by displacing the bullet in its passage.

The weight and elasticity of the air are properties which make it, of course, dense towards the surface of the earth, and rare and thin in the upper regions: so thin, indeed, it is on the tops of high mountains, that the lungs are scarcely satisfied by the quickest respiration, and a sensation of pain and difficulty of breathing, to an alarming extent, is experienced.

By chemical experiments on our common atmospheric air, it is found to consist of fluids of different qualities mixed together, any one of which, if breathed separately for a continuance, would cause death. The kind called hydrogen gas, is so much lighter than common air, that a quantity of it enclosed in a light vehicle, as a balloon, will rise from the earth, as we well know, and find its level in upper regions, where the air itself is as light, and

therefore can raise it no higher. This gas, too, is so inflammable, as to form the most brilliant and serviceable flame for artificial light. I need not remind my readers of the gas-lights, which give a midnight splendour to the streets of London, and our principal provincial towns

And now, if we speak of the uses of air, we must first mention its action in the lungs of animals. I cannot here state its operation and process within us, as a medical man would, but must content myself with saying that its presence, in renewed quantities, is every instant required by the nature of breathing animals. The lungs are like bellows, which have an irresistible power of their own, by which they expand and contract, so as to draw in and expel the air, without any trouble on the part of the breather, so long as the passages are clear and free.

Air, too, is the grand vehicle of sound, and transmits to the ear minute, trembling vibrations, which that organ, and no other, is constructed to perceive. It is found that a bell, placed beneath a vessel from which the air has been extracted, emits no sound.

Another grand use of the air is the diffusion which it occasions of the particles of light: this is called *the refraction* of the rays. There would be no such thing as dawn, or twilight, nor any light at all, in *the shade*, if the air did not reflect and diffuse the light generally in all directions, as water does the colouring quality of milk and other things.

Atmospheric air, again, is the grand nourishment of *flame*; and, in general, of the visible forms of heat. A candle placed in a closed vessel goes out, if the air be with-

drawn; as it does also, as soon as that enclosed with it has lost, by combustion, its inflammable qualities. If air, therefore, be forced in a stream against burning coals, so as to supply them faster than otherwise they would obtain it, the heat and visible fire are greatly increased.

Thus the consideration of air has introduced the fourth material subject to our attention, in the forms of light and heat. What these active and insinuating bodies are in themselves, we can no more tell, than we can say of what ingredients the moon may be composed. We can do little more than observe and describe some of the effects of these incomprehensible agents of nature.

Light, as we are obliged to conceive, consists of particles; but words, and even thoughts,

are clumsy things by which to represent them. Light is the messenger from sphere to sphere, whereby we are informed that our own globe is not the only one in creation: it is the heavenly witness, appointed by the Deity, to be continually before us, to testify of his near and of his distant power. The production and motions of light, are entirely beyond our comprehension. It appears that torrents of this celestial material proceed, with the swiftness of thought, from the countless suns of the universe, as from so many inexhaustible fountains. Their rays proceed at a speed which would make a cannon-ball appear a loitering traveller indeed, for nearly a hundred millions of miles are traversed by light in eight minutes of time!

The light of a common candle may be perceived at two miles' distance: its particles,

therefore, are flung in every direction, and would occupy a hollow vessel four miles in diameter! But this astonishing activity of material particles, in obeying the will of the Almighty, would seem useless without that delicate instrument, the eye. He who said, "Let there be light," formed, therefore, the eye, by which alone light seems to accomplish any purpose, and is known by us to exist.

Sir Isaac Newton succeeded, by continued experiments, close observation, and deep thought, in proving many facts with regard to light, which were unknown or obscure before. With regard to *colours* especially, he discovered that common, or white light, as it is called, consists of combined rays of varied hues; and that objects which we call red, yellow, and so on, have the quality merely of reflecting those rays, which fall with others upon them. To prove that the common

light of the sun contains the various colours, his beams may be made to pass through a triangular piece of glass called a prism, when the most beautiful hues of the rainbow are produced.

The particles of which heat is composed, are also so incomparably small and active, that they pass with ease through the hardest substances with which we are acquainted. This cannot be said of water, or of air. Heat generally increases the bulk of bodies, though it adds nothing to their weight. Metals expand very considerably, so that an iron rod is sensibly longer in summer than in winter. It is the presence of certain particles of heat which renders water, as well as metals and other things fluid, and which, if increased to a certain extent, dissipates even those fluids in aërial vapours.

I need not say that *cold* is nothing else

than a comparative deficiency of heat. It is perhaps impossible to say of any substance, certainly not of *ice*, that it contains *no* heat. We know little, in this country, of the fiercer consequences of intense cold experienced in polar regions, where heat is so scarce a commodity that brandy freezes and becomes a substance like a ruby, and mercury a solid metal like silver. How well that heat, the want or the excess of which is so destructive, should be measured out in such proportions as to maintain not only the lives, but the comforts of conscious beings.

Light and heat do not always accompany each other. The lustre of the moon affords no heat, whilst the warmth of many highly heated bodies produces not a spark of light: yet in the light of the sun, and artificial flame, they always go together.

OPERATIONS OF NATURE.

Having noticed some of the *materials* of which our accessible earth is composed, we will now observe a few of the results occasioned by the movements of these substances amongst each other. Of these some are usual, kindly, beneficial, and necessary; whilst others are occasional, terrible, and destructive.

We have already mentioned that beautiful process by which the waters, so essential to vegetable life, are first changed into buoyant vapours, that they may rise and overspread

the lands, and then are caused to descend in refreshing showers for the support of the blade, the leaf, and the ripened fruit. Beside this method, which is uncertain and partial, nature brings over the soil, at eventide, the land-mists and exhalations, which deposit copious stores of moisture on the day-burned plants and languid herbs of the field. But there is still another method by which the process of irrigation, as it is called, or watering, is accomplished in certain countries.

Egypt, anciently known as the granary of the world, has one vast river, the Nile, flowing through its whole length. This, however, would fertilize little more than the margin of the stream, if it confined itself within those narrow bounds. This is far from being the case: at regular seasons it rises, and at length overflows its banks for miles on each side, and

deposits at the same time an unmeasured supply of manure by the mud of its far-travelled and accumulating torrent. A few weeks after it has subsided, instead of a dreary expanse of waters, the eye beholds boundless plains waving with the finest corn and herbage.

But the watery stores of heaven assume other forms beside rain and dew—these are snow and hail. It seems that snow is a gradual formation of the particles of vapour into flakey morsels, which, by their expanded form and lightness, float gently down as the air permits them; whilst hail is composed of actual drops of rain encountering some cold current, and thereby frozen as they fall. These being (in proportion to their bulk) heavy, pass swiftly, and with some force, towards the earth; and in cases where hail-

stones are as large as walnuts, the shower nearly equals, in consequence, a discharge of actual stones.

Snow, in England, seldom falls in quantity sufficient to be much in our way. It is decidedly beneficial to the farmer when it falls soon after the winter wheat is up, and thereby forms a mantle to preserve the tender blade from the cutting winds and frosts. In and about the polar regions, however, the snow occupies the surface to an extent and depth which forbids the approach of man as a resident there. Yet mankind, unwilling to lose more than they can help of this earth's surface, push their dwellings to the very verge of possibility in the austere northern climes, and are content if the sun looks out with sufficient power to produce a patch of green earth for vegetation and the food of the

hardiest animals; nor do I think that those poor people, the Laplanders for instance, are at all desirous to exchange countries with their brother-men in southern latitudes. The earth even there supplies materials for the necessary wants of her family.

With regard to the air, some *motion* of its body is evidently needful, as is that of water, to prevent the most deadly putrescence. It has been found, that after a continued dead calm at sea, the surface has become one mass of noisome fluid; and confined air is known to be as instantaneously fatal as any poison to animal life. The Creator, therefore, has provided against these evils on a large scale, by appointing constant currents in the atmosphere, which operate ceaselessly on the bosom of the deep, and produce the restless, wavy surface of the sea. The means employed, or,

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as we say, the cause producing the effect called wind, is the expansion and contraction of the air by heat and cold in different parts, by which a rush from other parts is accomplished. This differs, in degree of force, from the scarcely breathing breeze which makes the aspen-leaf barely tremble, to the Indian hurricane or tornado, which carries all before it of less stability than the swelling hills themselves.

The Cape of Good Hope, as well as many islands in the West Indies, are famous for their hurricanes, and for an extraordinary kind of cloud which forewarns of their approach. This cloud, called by sailors the bull's eye, is seen at a great distance as a mere spot in the sky: at this time a perfect calm reigns over sea and land, whilst the

cloud grows broader until it invests the whole heavens with darkness. During this time, murmurs and strange sounds proceed from the caverns of the mountains; whilst animals, well aware of the impending calamity, hurry over the plains with their respective notes of woe, to their various retreats. Nothing can be more terrible than this tempest when it actually begins. The houses, made there purposely of timber, bend like card-boxes before the furious element: the sun, shut out as behind a thickened veil, leaves the land enveloped in almost midnight darkness, except when the gleaming tempest-fires lighten the terrific scene. The rain at this time descends, not in drops or in streams, but in torrents; so that Nature seems for a time as if intending the destruction of every vestige of her own more peaceful works,

as well as of the minute labours of her assistant, man.

I believe there is a distinction between hurricanes and tornadoes, and I find the latter is the most dreadful. This seems to be the effect of many tempests driving towards one unhappy spot: at this point the whirlwind begins with circular rapidity; the circle widens as it continues, and catches up every object that lies within its limits. The mariner would hail a driving tempest in exchange for this wild reel of the elements, which too often baffles his utmost skill and labour.

Then there is the sand-storm of Africa, which, raising the very surface of the desert in circling eddies, inters whole caravans and houses in one mingling mass of flowing sand.

But this seldom extends so far but that its influence may be avoided by those who are aware of its approach. Not so when the *simoom*, or hot poisonous wind of the Arabian desert blows. "At eleven o'clock," says Mr. Bruce, "whilst we were expecting soon to regale ourselves with a supply of good water, one of the Arabs suddenly called out: 'Fall on your faces, for here is the simoom!' I saw from the south-east a haze coming, in colour like the purple part of a rainbow. I could scarce find time to fall upon the ground, with my head to the northward, when I felt its peculiar heat: it was indeed of an intensity to threaten suffocation.

These winds, which are really *scorching*, are moreover charged with a cloud of sand, so fine and insinuating as to enter chests however firmly closed; and therefore they

invade the lungs, and cause the most agonizing death to thousands.

But there are motions of the air, as of the sea, which are regular in their directions at certain seasons. A flow of water to particular parts is called a *current;* that of the air I now refer to, is called by some the *monsoon*, or trade-wind, because it favours so greatly the periodical traffic on the ocean of commercial nations. There are many parts of the world in which wind, so uncertain with us, is as constant and invariable as the seasons.

The most regular and often-repeated operation of nature, in the motion of fluids, is that of the tides, or the rising and receding of the sea, discerned most plainly on every coast or shore. The water is observed to flow for certain hours, from the south towards the

north; in which flux, or flow, the sea gradually swells for about six hours, it then seems to rest for about a quarter of an hour, and then retires for six hours more. Thus has the sea alternately risen and fallen twice a day since the creation. After much wonderment for ages, this circumstance of nature has been clearly ascertained to be caused by the attraction of the moon, which draws a sort of hillock of water towards herself, as the earth turns round.

A water-spout is a sort of twisted column of water, which is drawn up towards the clouds, whilst the cloud descends in a column towards the sea. This appearance sometimes has the form and colour of a column of smoke. It is dreaded by mariners, because, when it bursts, a deluge descends which sometimes sends a ship to the bottom.

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The Simoom.

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Waterspouts.

A whirlpool is a more dangerous thing by far: it is a circulating, funnel-shaped current in the sea, caused, it is supposed, by some vast aperture below, through which the ocean pours to some unknown abyss. So wide is the operation of this mischief, so powerful, and withal so deceptive, that vessels are often drawn into its influence before any danger is perceived. It is seldom the case that any exertion of the unhappy crew will extricate them from their swiftly revolving motion: the tendency is, in lessening circles towards the central gulf, in which a navy would be swallowed up as easily as a feather. The most celebrated whirlpool is that of Maelstrom, on the coast of Norway.

With regard to those operations of nature, of a dreadful kind, with which we are, in this country, most acquainted, tempests of thun-

der and lightning are the chief. The clouds seem to be the grand electrical machine by which this effect is produced. Dr. Franklin first had the sagacity and boldness to add this truth to science. During a thunder-storm he sent a paper kite on high, having twisted round the string a very fine metal wire: he then found that the electric fluid descended, and was to be drawn forth in sparks, as from his own instrument, constructed for that purpose. It is a little curious, that many persons are more frightened at the thunder than the flash: it is certain, however, that when the thunder comes, all danger arising from that electrical discharge is over.

Lightning travels from cloud to cloud, and sometimes downwards to the earth, to supply a deficiency from an abounding store. We do not know what electricity really is.

And now a word on earthquakes, the last of nature's angry movements which I shall mention. Of these we know scarcely anything but the sad effects. Men are apt to think the earth a *steady* friend; but they are sometimes mistaken here, for the sea, on certain occasions, is the only safe retreat. Subterranean fires, caused and maintained, we know not how, certainly exist; and if they do not obtain a crevice, or chimney in a volcano, they rumble beneath the ground, and heave the earth for miles in the endeavour to escape. Britain is little subject to this most dreadful calamity. Earthquakes have laid waste whole kingdoms. Twelve cities in Asia Minor were, as Pliny tells us, swallowed up in one night. In the time of Justinian the city of Antioch was destroyed with forty thousand inhabitants, which was the second visitation there; and the same place was a

third time overturned about sixty years after.

One of the most famous earthquakes in history was that of 1693, the damages of which were chiefly felt in Sicily; but it extended, in fact, to a circumference of six or seven thousand miles. Its motions were so rapid, that those who lay at their length were tossed from side to side, as upon a rolling billow. Not less than fifty-four cities, with an incalculable number of villages, were overturned. The city of Catania, in Sicily was, in an instant, buried in a new abyss; over which hung nothing, the next instant, but a cloud of dust in the air! Nineteen thousand persons perished thus in less than three minutes.

Earthquakes in the West Indies, particularly in Jamaica, have been very terrible.

But we cannot search the globe now in pursuit of these terrors. I shall only now mention, that the city of Lisbon, with sixty-thousand inhabitants, was swallowed up in the year 1755, and this is the most recent of the great earthquakes of history.

Such are a few of the great operations of nature, with the materials of which we have given some account. Still there is an overruling Providence which prevents the utter breaking up, at present, of the usual order of things; so that the earth, notwithstanding these partial convulsions, holds on her course, revolves under the life-giving sunbeams, and thus supplies food and comfort to her innumerable tribes of creatures. Let us remember, however, that the duration of all this is limited by the word and will of Him

who created all, and that there is an appointed time when a final conflict of the elements will perform the Almighty mandate, that "Time shall be no longer!"

PRODUCTS OF NATURE FOR THE SUPPORT OF LIFE.

We have taken some notice of the vast machinery of creation, as exhibited in the form, motions, structure, and materials of the earth; and have attended to the grand operations of those materials or elements with each other. But the earth is a tenanted estate, a peopled domain: creatures with life and consciousness exist, and possess bodies subject to continual change of substance, from waste and renewal. Of what kind, then, is the added material of the animal to be? The Creator could

no doubt, have maintained life in animals, as in vegetables, by causing them to imbibe particles without their effort or their knowledge. But his wisdom ordained otherwise, and appointed that the substances, by which *conscious* life should be maintained, should be prepared *for* them by a previous process, and received *by* them, not as particles insensibly absorbed, but as food, obtained and consumed by a voluntary act.

The vegetable kingdom is the grand repository for animal supply. True it is, that animals live on animals to a great extent; but if we trace the origin of even this food, we shall find that the grass, or the herb, or the fruit of the field, formed the general source of sustenance; and we find the steps are rarely many between the forest and the field: or, to be more plain in the statement,

the ravenous tribes prey directly on the grass-eating, or grain-eating herds, if they can.

Of what then does this vast supply of vegetable food consist? We may answer, in *a general way*, of HERBS, ROOTS, FRUITS, and GRAIN; chiefly, however, of grasses and their seeds, and trees with their fruits. Now, let us think awhile, and admire the appointment of the Creator. A thousand millions of mankind, and unnumbered millions of beasts, are to be daily supplied with food. Is the grand staff of life formed of massive substances like the burly oak, or of the ponderous produce of the gourd? No: the tender and diminutive stem, and fine, taper leaf of the creeping grass, with its small, delicate seeds, form the foundation on which life generally rests for support! And seeing this is so, can we not find out some wisdom in the appointment,

even by the light of our feeble reason? Had food been produced in large masses, it is plain that a vast waste would have been occasioned by any disease or accident happening to that mass. If the root of a gourd be withered, or the fruit-stalk broken, a thousand times the quantity of produce perishes, more than if the same thing happen to a plant of grass or corn. So that even supposing that those gourds were *quartern loaves ready baked*, we should have a more precarious supply of bread, than now that we depend for it on grains, a hundred of which, perhaps, scarcely form a mouthful. Besides this, the tiny products of the grass and corn tribes (for all sorts of corn are grasses) can spread their roots, and rear their slender stems on soils and in places, where larger fruits would perish from lack of moisture, or rot from its abundance.

The grasses, of which the varieties are perhaps a hundred, follow man nearly to the polar regions. They grow beneath his heedless and injurious footsteps; they mantle his wide domain in a perpetually enduring vesture. If not in the form of grain for his own immediate use, in that of the blade for his flocks and herds, they minister to his ceaseless wants, and become the great gift of God in the way of subsistence for his frame. It is the fact, too, that wheat, the most important of vegetables, will exist where other kinds would perish; and it endures vicissitudes of climate and of seasons, which would destroy many less valuable crops. Still, a variety of grain was desirable, and a *wonderful* variety has been created. Wheat, oats, barley, rye, rice, Indian corn, and podded seeds, are a few of the important individuals amongst the vegetable classes, on which the

great bulk of mankind depend for existence, as consumers of the seeds of plants.

But grass, commonly so called, is the staple diet of the herds of animals, from whence we derive our richer supplies of milk and flesh. Whole nations of men practise no agriculture at all, but lead their flocks from place to place. The cow and the sheep reap the always ready harvest, and transform the herb into the substance of which man can readily partake.

But important and prominent as the grasses are in the stores of human food, and various as are their kinds, other forms of vegetables are multiplied almost infinitely for his necessities or comforts. Roots form a simpler and more ready kind of sustenance for some, than the herb or its grain. The potatoe is

a sort of bread, as soon as it has undergone the common action of fire; and where men are formed into thickly peopled societies, many must be content with the less esteemed supplies, whilst the few are fed with the finest of the wheat. Roots, again—such as potatoes, turnips, carrots, and others—are a further supply for cattle, and particularly a winter provision when the blade fails; and they relieve the soil by a change of crop, which constant produce renders necessary.

With regard to fruits, or the produce of trees and shrubs, we may see in them, generally, a provision of *luxuries*, as well as of necessaries, for man. The olive and the vine are to "make glad the heart of man," or "cause his face to shine;" whilst the lemon, the orange, the fig, the pomegranate, the apple-tree, with countless other varieties,

are added to show forth the loving-kindness of God, and to convince us, that whilst he causeth the grass to grow, and herbs for the service of man, he has not been unmindful of those peculiar delicacies and refreshments, which the heat and burden of the day of toil render grateful to his taste. And whilst dainties are thus provided for him, so they are for the beast of the field. The tender blade is plentifully intermixed with rich and succulent herbage of every leaf and flavour; and we may see how the horse, the ass, the cow, the goat, respectively cull out the sorts most agreeable to their natures.

The growth of vegetables, even of a blade of grass, is utterly beyond the comprehension of the most observant and reflecting mind. We can understand, indeed, how the vast machinery of nature, to which we have before

referred, supplies a constant circulation of fluids for its increase; but how it receives those particles, and transforms them into the leaf and the seed, we know not. Many things will imbibe moisture; but only those which have the mysterious principle of life, increase and change in substance by the process, putting forth the leaf, the flower, and the fruit in its season. Such a fact as this, is a wholesome one for those to reflect on, who wish to watch the hand and footsteps of Deity, in the present order of things. What is it but an Almighty power and wisdom, which causes the seed, dropped into the earth, to send the blade upward and the root downwards; so that a mistake never happens by the contrary movement?

The life and constitution of vegetables are so admirably ordered, that there is scarcely a

soil or a clime, to which some variety is not suited. The ardent plains of the South, produce the stately palm, the clustering vine, the shining olive, the fragrant citron, lemon, and orange, and the glowing apple, as well as the waving corn; and if we turn to the regions where ice is the shower, and snow the harvest, we shall still find, if not some hardy varieties of grass, the thickly matted moss, which, beneath the snow, is reserved as the *destined* food of the reindeer, which is the *destined* food of the Laplander, or the Kamtschadale, who are the *destined* inhabitants of the northern zones.

The spread and propagation of vegetables is another subject of admiration to the intelligent observer of nature. The grasses, as being the most important supply, push their fibrous roots from side to side, till a continent

is covered, and they shed innumerable seeds as well. In other cases, where the fruit containing the seed is less likely to be reserved for sowing, the principle of life is so implanted in the branches, that a small slip, or cutting, will send forth roots, and become a distinct tree, as in the vine.

But the flocks and the herds, the fowl of the air, and the fish of the sea, were also given to man for food. They were, therefore, to a great extent, placed under his dominion and his care; thus myriads of animals are in the enjoyment of life and plenty, which otherwise never would have existed. It is true, the wild bull grazed upon the plains, the timid sheep browsed on the herbage, the goat skipped upon the rock, before man had provided for them the crib, or the stall, or the fold; but these would never have covered a

thousand hills as they do, had it not been for the herdsman and the shepherd, who for his own sake supplies, shelters, and protects them.

The flesh of beasts was an express gift of God to man after the flood, and it is found to be a support and a stay, highly needful to recruit the wasted frame of him, who toils in mind and in body, amidst large societies of our race. But the Creator has bestowed a vast provision of animal substance, which may be obtained without the death of the creature. Thus we hear of lands *flowing with milk and honey:* and I need not remind my readers of that grand portion of their own food which probably consists of milk and its products,—I mean cheese and butter. Thus, by a very quick process, the dewy herbage, though itself unfitted for the food of man, is

transformed into the most wholesome, strengthening, and agreeable nourishment. In a few hours the grass and trefoil of the pasture are seen in the form of milk, cream, and butter, on the breakfast-table. By this wise arrangement opportunity is given for an incomparably larger number of feeders to be supplied, whilst a luxurious variety is provided.

But food is not the only want of man: he must have clothing. Here we may observe that nature does not supply us so directly, and with so little labour and skill on our part, as with food, which is necessary for the hourly support of life. For raiment the Creator has given immense stores of materials, and the requisite ability to the mind and finger of man for their *manufacture*. The skins of beasts, indeed, with very little preparation, may be, and are, worn by those who have few

means or notions of convenience or comfort about them. The savage takes the reeking hide, and makes no further use of his strength and sagacity than that of appropriating to himself the covering which existed just before on another body. But mark the difference! Civilized man takes the same skin, and divests it of all resemblance to its original appearance; he separates, cleanses, twists, and weaves the hair; he purifies, and thereby preserves from annoyance and destruction the hide; and by the due exercise of those gifts which God has bestowed upon him for that purpose, he preserves and produces a covering beautiful, convenient, durable, and agreeable, for his own use as a civilized man.

I know not whether the variety and suitableness of these materials for man, or the

versatility of his faculties for their application to his service, ought most to call forth our admiration of Providential appointments. As the material, the mind, and the hand, are all *His* work, we must be "still praising Him" whichsoever way we turn. The vegetable world supplies, generally, the whiter clothing, as linens and cottons; whilst in silks, woollens, and leather, we are reminded of the worm, the sheep, and the ox; who, as Dr. Watts says,

——————"Wore
That very clothing long before."

Silks are generally the vestures of the wealthy; and how surprising it is that the diligence and powers of so small an animal as the silk-worm should be the source of so vast a supply, and so splendid a production as this!

Wool has a quality quite distinct from any other hair, and which seems appointed expressly for the peculiar wants of man; for the sheep cannot experience its benefit—I mean the tendency *to thicken up*, by minute contraction, as it is woven and dressed into cloth. Any other hair or thread may be woven, it is true; but the substance is, after all, only like so many hairs, or threads put together; but wool has, when prepared, the appearance almost of an entire substance, the separate threads of which cannot be perceived. Again, wool presents the greatest obstacle to the transmission or passage of heat, perhaps of any substance; it therefore is the warmest covering known; for it imprisons around us the natural warmth of our bodies. It is not wonderful, then, that woollen goods are the grand staple article of apparel in nearly all but tropical climates. The

sheep, therefore, accompanies man almost to the arctic regions.

We have only time to hint at a few things connected with our subject, and must now pass on to the third grand necessity of man—I mean shelter. The milk, and the flesh, and the fleece of the flock, will not make him better than a savage, without a residence wherein his comforts can be preserved and himself protected. What is to be done? There are caves and dens; but their fierce possessors will not give them up! Man *must* again go to work, and to work he goes, not with an unfurnished mind, however, or an empty hand. The forest, whose stately pillars form the midnight temple of the roaming herds, must bow before him. The earth, as we have seen, must yield her metals and her stones; nor has one sort of

wood, or one sort of metal, (even the best, in some respects, of any,) been deemed sufficient by the Creator, or by man, for his multifarious purposes. Oak and iron would have been rich gifts alone; but how many sorts of timber and of metals have we beside? Oak is hard; but difficult to be wrought, and slow in growth. Iron is hard too, and able to separate timber, and is plentiful; but iron rusts, and is difficult to melt. So we have cedar, and mahogany, and fir, and chestnut, and beech, &c.; all with different qualities, suitable for varying purposes. Then we have the metals before named, whose properties are just those which supply each others deficiency. Of this we have previously taken notice.

Now there is a circumstance well worthy of observation here, which is, that these ma-

terials of life are most abundant in temperate climates, where life can be best enjoyed. There is small waste in the distributions of nature. Things are generally placed where they will be made the best use of; and it is by this use that the mind of man is exercised and civilized. Now, if we view the structure of a modern dwelling, how innumerable must have been the thoughts and contrivances of some heads, in the original invention of implements, adaptation of substances, and general form and result of the whole. Begin at the top—formed with tiles, slates, or lead: well, tiles are formed of a peculiar sort of clay—that must be *found out*. They must be hardened by heat; yes, but that too, with the exact method, must be discovered. Then how are they to be placed? So, or so, or so? No, the rain will find a crevice at the next tile. Well then, *so*,—lay them sloping side by side, beginning at the bottom

row; place the next row lapping over more than half, and so that the edge of one tile comes under the middle of another. Will that do? Yes; but they will drop out. Oh, then we must have them made fast with pegs, and lay them upon laths. True, but pegs and laths, I have none. Then cut some pegs, and split some laths. But how, and with what tools? All this, you see, must have been thought about, and found out by somebody long, long ago.

But perhaps you will smile at my beginning at the top of the house. Persons must commence at the foundation, and perhaps that may be easier. I doubt it. Level a piece of ground. How? We must have a mattock, spade, shovel, pickaxe, and then something to tell us that the ground *is* level at last. All these tools must be formed from

the earth, by processes which we know require much knowledge. But we will suppose these at hand, and that some one, by spreading water on the spot, has found out that the surface *is* pretty level. The foundations are dug: what then? The same difficulty occurs with bricks as with tiles, regarding their formation. Stone would, I presume, be quite as handily obtained. Wood is, perhaps, most ready of all, but it must be sawn; and who could not build a house as soon as make a saw? These are some of the things which strike us, in looking at the mere external frame-work of a house; but think of the planing, the fitting, the plastering, the colouring, the painting, the glazing, the plumbing, the paper-hanging, the decoration, the furniture! For the innumerable requirements connected with these, materials have been provided by nature, selected and applied by

man, and society now has the benefit, without the anxiety of invention, or the labour of unsuccessful contrivance. Amongst savage nations *materials* have been few which the mind of man has had to work upon, and it has remained comparatively idle; and whilst the understanding is thus torpid, the soul itself never half awakens to a sense of its condition or destination. The whole of existence is occupied in the mere effort to procure food, which is eaten almost in its raw state. There are, however, other causes which may be found to explain the continuance of savage life. A natural indolence prevents men from using the powers or materials they have, and this may be seen amongst ourselves too often.

It appears, then, that the minds of men are not less benefitted than their bodies, in the vast and varied provisions and materials of

nature around us. Civilization advances by the application of these through the exercise of the faculties to the purposes of life. And when the mind is once set to work, it finds pleasure and profit in occupation, and does not cease because it has attained one object; another beyond, starts up, and tempts us to pursue. The necessary arts of life gave rise to the finer employments of the invention, the judgment, and the taste. All these kept the intellect still active: the principles and powers of nature were sought out, the facts of nature deeply studied, and the sciences became results and themes of contemplation.

When men began thus to think and study, the stores of knowledge required more room; some method was needed to register them,

and secure their possession to future ages, or men, who did not happen to learn from their parents all their parents knew, would have to seek afresh for that which had been already discovered—hence arose the invention of letters. To perpetuate ideas by visible signs, was to give the discovery of one age, to every succeeding one. The natural intelligence and sagacity of man, seized upon this discovery, and a new motive was given to the pursuit of knowledge.

But we may go far, very far, in finding out causes, and yet stop far, very far, short of the truth. It pleased God to provide for the revelation of his own mind and will to man, by the suggestion to the human intellect of *literature*, by which that revelation should be made known to the world.

There is abundant reason to believe that letters were first used in the East, and I cannot do less than conclude, that as the Scriptures were committed to writing, before any other known books, the Deity suggested, by direct inspiration, the method as well as matter of the first volume that was produced.

In this volume the study of nature is abundantly encouraged and assisted. The Psalms are full of the admiring thoughts of a *pious naturalist*, such as David unquestionably was. The 104th, in particular, is applicable to the subject of this little book, and sets forth the provision of God for man, in the most striking point of view.

But *this world* is not the grand object set forth in that inspired volume. The present scene of things, however admirable, we