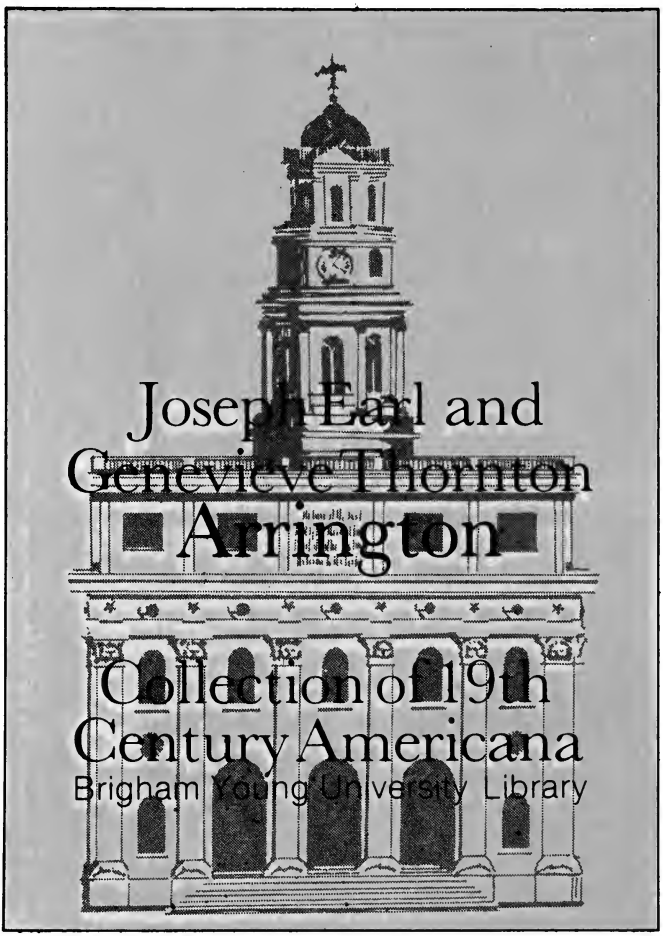

VIEWS

OF

THE CREATION.

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PREFACE.

In this Book, it has been attempted to supply the means of exercising and strengthening the reasoning faculties of children, and of giving a salutary direction to their opening powers of observation.

It will depend a good deal upon the natural understanding as well as upon the previous education of the child, to determine at what age this volume may be put into its hands.

Experience has proved that, in some instances, eight or nine years old is not too early.

It will be observed that the works of Paley, have supplied the principal materials; other eminent writers, however, have occasionally been laid under contribution. The part which relates to astronomy is new.

VIEWS

OF

THE CREATION.

WE ought never to contemplate the appearances of nature, without reference to the Supreme Being, by whom nature was created.

When we have made this the ruling sentiment of our minds, we shall have laid the foundation of religion.

Then will the world be itself a temple, and our whole life one continued act of adoration.

The change is this, that whereas, formerly, God was seldom in our thoughts, we can now scarcely look upon any thing without thinking on Him.

Every natural body then becomes, in our eyes, a witness of the care of the Creator.

The contrivances which we meet with in the natural creation, surpass the contrivances of mechanism, in number and variety; and in a multitude of cases, they are themselves evidently mechanical, and as evidently contrivances, and as fit for their objects, as are the most perfect productions of human ingenuity.

If, for example, we compare the eyes of different animals, we shall find one general plan laid down for all, and that plan varied only just so much as the objects of each may require.

In the eye itself, we behold a machine which none but an Almighty artist could have constructed.

Let us, however, first consider what it is that composes an eye. It contains three distinct substances, shaped like the glasses in a telescope: there are further, between these, three clear and transparent liquids, which allow the rays of light from the object freely to pass through; there is

next, a black curtain, (the only membrane of the body which is black,) spread over the back of the eye, so as to receive the image through these transparent substances, and placed at the precise distance behind them, at which, and at which alone, a distinct image could be formed. Finally, there is a large nerve communicating between this curtain and the brain; without which the effect of light upon the curtain would be lost, that is, it would produce no sensation.

The manner in which sight is produced may be understood by taking the eye of an animal, (a bullock or a sheep,) which has just been killed, and having closed the shutters of the room, placing it at a hole or chink in the window, through which the light enters. Whatever object is presented to this eye, will then be found to have an accurate picture of it painted on its back part.

The coat of the eye which receives this picture is an exceedingly fine and thin membrane, and, as has been mentioned, communicates with the brain.

Let the young reader, who has never reflected on the value of sight, think what would be his situation if his eyes were closed in darkness; if he could neither look

upon the cheerful sun, nor the green fields, nor walk along the road without fear of meeting with some accident.

Let him also bear in mind, that the eye is the tenderest organ of the human body.

Though this, however, be the case, let us carry our examination a little further, and we shall have still further reason to admire the wisdom and the goodness of our Creator; for in every thing belonging to it, there may be seen the extraordinary care he has taken to preserve it.

In considering the power of sight, we can never reflect without wonder upon the smallness of the picture which is formed in the back of the eye, and the fineness of the lines in which it is drawn there. The largest landscape is brought into a space of half an inch in breadth, yet the multitude of objects which it contains, are all preserved and distinguished, in all their sizes, places, shapes, and colours.

The prospect from the highest mountain covers a space not larger than a coin of five-pence; and a stage-coach, passing at its ordinary speed for half an hour, passes over in the eye, only one-twelfth part of an inch. Yet this change of place in the image is

distinctly perceived throughout its whole progress.

But it is a reflection which the view of nature leads us every hour to make, that in the hands of the Creator, great and little make no difference.

It is a very curious fact, that the inside of the eye displays an exact resemblance to a telescope, but infinitely more complicated in its parts, and, at the same time, infinitely better adapted for its purpose.

Any one who has ever looked through a telescope knows, that in order to see an object that is distant, he must draw out the tube which has the eye-glass at the end of it—and that to see an object that is near, he must put in the tube.

Now the very same thing is done, at once, by the eye, for it is furnished with a number of little strings, called muscles, which enable it at once, when occasion requires, to lengthen or shorten the distance between the coats of the eye, which are, in fact, similar to so many glasses.

There is to be seen, in every thing belonging to the eye, an extraordinary degree of care for its preservation.

It is lodged in a strong, deep, bony socket, composed by the joining of seven

different bones, hollowed out at their edges.

Within this socket it is bedded in fat, the best adapted of all animal substances, both for its repose and motion.

It is further sheltered by the eye-brow, an arch of hair, which, like a thatched pent-house, prevents the sweat and moisture of the forehead, from running down into it.

But it is still better protected by the eye-lid, which is always ready with inconceivable quickness to defend the eye, to moisten it, and to close it in sleep.

Are there any purposes discoverable, in any work of art whatever, more evident than those which the eye-lid fulfils? If it be overlooked by the observer of nature, it can only be, because it is obvious and familiar.

In order to keep the eye moist and clear, (which qualities are necessary to its brightness and use,) a wash is constantly supplied to the eye for the purpose, and the superfluous moisture is conveyed to the nose, through a hole in the bone as large as a goose-quill.

When once the fluid has entered the nose, it spreads itself upon the inside of the nostril, and is dried off by the current

of warm air, which in the course of breathing is constantly passing over it.

What an admirable contrivance, not only for keeping the eye in that state on which sight depends, but also for carrying off the moisture, which, having once performed its office, is no longer necessary.

Here is a hole cut through a bone, and a hollow channel running from it, which removes the moisture when it has performed its office, or is produced in greater quantities than is required.

It is a remarkable proof of wisdom, which prevails through nature, that this liquor which moistens the eye, and the hole which carries off the liquor, is not found in fishes, because the water in which they live supplies a constant wash for the eyes.

Were we to turn our attention to this alone, of all the Creator's works; the examination of the eye, its coats and humours, its transparency, the shape of the transparent body within it, which forms the picture of the thing seen, the black curtain behind the eye, on which the picture is painted, the eye-lid, the communication with the nose—all forming an apparatus so manifest in its design, so exquisite in

its contrivance, so precious, so infinitely beneficial in its use, it would be sufficient to call forth all our feelings of admiration, praise and thanksgiving.

It would be quite too absurd to say, that all this should have taken place, merely because something must have occupied those points in every animal's forehead—or that all this can be accounted for by the short answer, "that whatever was there must have had some form or other."

What has chance ever done for us? In the human body, for instance, accident may produce a wen, a wart, a mole, a pimple; but it never produces an eye.

Chance never produces an eye any where else; for instance, in the knee, or in the shoulder.

A clod, a pebble, a liquid drop, might be supposed, by the ignorant, to be the effect of chance; but never was a watch, a telescope, or a machine of any kind, so produced.

In no instance hath such a thing been ever supposed to have existed, without some one having contrived it.

If there were but one watch in the world, it would still be certain that it must have

had a maker—we should still be as perfectly assured that it proceeded from the hand, and thought, and skill of a workman, as if we visited a watch-maker's shop, and saw collected there twenty different kinds of clocks and watches: each machine is a proof independently of the rest. So it is with respect to the Deity.

If, from the eye, we proceed to examine the ear, we shall find the same evidence that it was formed by an All-wise Workman.

It would be difficult to make the reader understand all the parts of this organ; we shall, therefore, confine ourselves to those particulars which it may be easy to explain.

Let us consider why it is that, in all animals, the Almighty has made that organ double :—may we not believe, it was in order that sound might come to them more quickly, and also as a wise provision in case one of them were to suffer any injury.

The sense of hearing, as that of seeing, depends on a nerve, which carries the sounds to the brain; hence, when we consider how often we are warned by sounds of the approach of danger, we must admire the wisdom of the Creator, who hath

placed it where it can give the most speedy information.

We may observe, also, of its outward shape, how admirably it is adjusted to the peculiar occasions of each animal. In man, it is of a form proper for the erect posture of his body.

In birds, it is of a form proper for flying, not projecting, (for that would hinder their passage through the air,) but close and covered up.

In four-footed animals, its form is various. In the Hare, which thinks only of escaping pursuit, it is directed backward, so as to take in the most distant sound that comes behind her. In those that hunt after their prey, it is turned forwards, in order to receive notice of the object which they pursue.

In the Mole, which is forced to mine and dig for its food and habitation, there is no outward ear, but a hole between the head and shoulder, lodged deep in the back part of the head, and covered with thick, short fur, to preserve it from being torn or injured.

We may better understand the use of the outward ear of man, by remarking, that when it has been by any accident cut

off, the hearing is confused, and the person is obliged, either to form a cavity with the hollow of the hand, behind the ear, or to make use of a horn, in order to receive the sounds.

The passage from the outside to the bottom of the ear, also, is most deserving of our attention. If it had been fleshy, it would have deadened the sound:—if of bone, it might by many accidents have been broken off. It is, therefore, formed of gristle, which is sufficiently smooth to give sounds an easy passage; besides this, it winds something like the arched chambers of a snail's shell, so as to encrease, as well as improve them.

It is evident, that even when we sleep, the ear should be ready to receive those sounds which announce approaching danger; hence it differs from the eye in that respect, that it is always open, always upon the watch.

To guard against those noxious insects which might enter, as well as to preserve it against the injury of the air, God has furnished it with a very bitter gluey wax, which is produced from a number of little vessels, placed there for that purpose.

We now come to speak of the manner in which hearing is produced, as well as of the inside of the ear, and it may be remarked, that as the eye has been compared to a spy-glass, the ear resembles, in several particulars, a drum.

At the bottom of the passage described, and stretched across a circular opening in the temple-bone, is a thin, dry, firm, and transparent skin; against this, the noises strike, as noise is produced by beating upon a drum-head.

Inside the cavity of the ear, there are three small bones, fastened to each other and to this skin, as well as to the nerve of hearing, which are called, on account of their shape, the hammer, the anvil, and the stirrup, and serve to tighten and loosen the ear-drum, as the braces do in the war-drum.

If the noises are too loud for the nerve of hearing, these little bones, without our knowing it, move a muscle, which relaxes the skin. And when the noises are too low, or the hearing imperfect, they stretch it so as to make the striking sounds more effectual upon it.

But there is still another point of resemblance between the ear and the war-drum;

it is well known that in the side of the latter there is a hole, which allows the air to pass in and out, and makes the drum-head sound the better.—Now just such a hole as this is found in the inside of the ear, and communicating by a long narrow pipe, or canal, with the mouth, so that the air passes freely into the cavity.

Let us consider the purpose for which all this wonderful mechanism is contrived. It is the sense of hearing which makes speech so valuable, for by the two together we make known our fears, our wants, our pains, our sorrows, our pleasures.

Who, then, can reflect upon all this curious apparatus, as well as its use, and withhold from the Creator his due praise? Who can survey all this, and not own it to be the work of an omnipotent, an infinitely wise and good GOD?

The eye proves the beneficence of the Creator without the ear: the ear proves it, also, without the eye: the proof in each example is complete.

Let us now consider the stomach, and we shall there, also, find the proofs of the Creator's care and design no less evident.

In the human stomach, for instance, what a variety of strange substances are,

in a few hours, reduced to an uniform pulp.

This is by the action of a most extraordinary liquid in the stomach, called the gastric juice. It seizes upon and dissolves the texture of almost every thing that comes in its way.

All kinds of flesh, the seeds and fruits of the greater number of plants, the roots and stalks, and leaves of many, hard and tough as they are, yield to its powerful force. The change wrought by it is different from any which we can produce by art.

There was once a sailor, who, in order to raise the astonishment of his companions, used to swallow one, two or three pen-knives. However, he suffered, at last, severely for it. After frequent repetitions of this experiment, some of them remained in his stomach, and in time caused his death—so curious a circumstance produced a great deal of interest; his body was opened, and the knives were found more or less eaten away by the action of the gastric juice.

Consider, moreover, that this fluid, stronger in its operations than boiling water, or aquafortis itself, is, nevertheless, as

mild as our spittle when tasted or touched. Indeed it very much resembles our spittle in its appearance.

Consider these several properties of the stomach, and of the juice with which it is supplied, and you will confess it to be entitled to a name which it has sometimes received, that of "the chemical wonder of animal nature."

There are about twenty different fluids separated from the human blood, the most unlike one another in taste, smell, colour, and consistency; thick, thin, salt, bitter, sweet. These are called the secretions.

By secretions, we mean the gastric juice, the saliva or spittle, the bile, the slippery oil, which makes the joints supple, the tears, which moisten the eye, the wax, which defends the ear, the milk of a nurse, the sweat, which relieves us when overheated, and other matters.

All these proceed from the blood; and further than this, the same blood is converted into bone, flesh, nerves, membranes, tendons; things as different from each other as wood and iron, canvas or ropes, of which a ship is composed.

If we look to other kinds of animals, we find amongst their secretions, not only the

most various, but the most opposite properties; the most nutritious food, the deadliest poison, the sweetest perfumes, the most fetid smells.

We have no operation of art with which we can compare all this, for no other reason, perhaps, than that all operations of art are exceeded by it.

The productions from the blood, in these instances are very different, and the difference exactly adapted to the work which is to be done, or the end to be answered.—No account can be given of this without resorting to the appointment and design of an all-wise and beneficent Creator.

Why, for instance, is the spittle which is diffused through the mouth, which is the seat of taste, insipid, whilst so many other of our secretions, such as the tears and the sweat, are salt?

It is for the purpose of not interfering with the taste of the different matters which we eat and drink.

Why does the gland within the ear separate a tough substance like wax, but the gland in the upper angle of the eye, a thin brine which moistens the ball?

It is because the ear wants to be defended, and the eye requires to be washed.

Why is the ointment of the joints oily, but the bile bitter and sharp?

Why does the gastric juice which flows into the stomach, contain powers of dissolving every substance fit to be taken into the stomach?

These are all fair questions, and no answer can be given to them, but that these are means adapted by their Creator to their different ends.

In considering the joints, there is nothing, perhaps, which ought to move our gratitude more than the reflection how well they wear. A limb shall swing upon its hinge, or play in its socket, many hundred times in an hour, for sixty years together, without diminution of its force.

This is a long time for any thing to last; that is, for any thing so much worked and exercised as the joints are.

We can never repeat too often, how many things must go right for us to be an hour at ease; how many more for us to be vigorous and active.

Yet strength and health are far more common than weakness and disease, notwithstanding that our bodies depend upon so great a number of instruments of

motion, and notwithstanding that the disorder of a very small matter may be attended with grievous inconvenience.

With much compassion, (says an eminent writer,) have I considered the state of a certain gentleman, who was in pretty good general health, but only wanted the use of the two little muscles that serve to lift up the eye-lids, and so had almost lost the use of his sight, being forced, as long as this defect lasted, to shove up his eye-lids every moment with his hands.

In general, we may remark, in how small a degree those who enjoy the perfect use of their organs know the extent of the blessing, and the variety of their obligations to Providence. They perceive the happy result; but they think little of the multitude of contrivances which go to produce it.

The variety, quickness, and precision of which muscular motion is capable, are seen in no part more remarkably than in the human tongue.

It is worth any man's while to watch the nimbleness of his tongue.

The wonderful readiness with which it changes its place, and the perfect exactness of its motion.

Each word, and even each syllable, requires for its utterance a particular action of the tongue.

One, and only one, position of the tongue will produce any particular sound correctly. How instantaneously are these positions assumed and dismissed, how numerous are the changes from one to another, and yet with what certainty are they made.

The anatomy of the tongue corresponds with these observations upon its activity.

The muscles of the tongue are so numerous, and interwoven with one another, that they cannot be traced by the nicest dissection.

Let us consider the parts of the mouth in some of their properties.

Nine hundred and ninety-nine persons out of a thousand are, not only able to talk, but also to taste and swallow very well, and all by the help of the tongue and mouth.

In fact, the constant warmth and moisture of the tongue, the thinness of the skin, the pores upon its surface, qualify it for its office of tasting, as much as its multiplicity of fibres do for the rapid

movements which are necessary for speaking.

There are brought together within the mouth, more distinct uses, and parts which execute more distinct offices, than can be found, within the same compass, in any other portion of the body; for instance, teeth of different shape, first for cutting, secondly for grinding,—and muscles, by which the mill of the jaws is worked—and fountains of spittle, springing up in different parts of the cavity for the moistening of the food, whilst the chewing is going on—and glands to feed these fountains—and a muscular action of a very peculiar kind in the back part of the cavity, for the guiding of the chewed food, in its passage towards the stomach, and for carrying it along that passage.

In the mean time, and within the same cavity of the mouth, is going on another business, altogether different from what is here described, that of breathing and speaking. For in addition to all that has been mentioned, we have another passage opened from this cavity to the lungs, for the admission of air only.

We have muscles, some in the throat, for the purpose of making the air, in its

passage, produce all those varieties of sounds and tones, which are used in speaking all the languages of the earth.

How poor is the contrivance of any musical instrument compared to the human mouth.

In no work of art are there so many uses so aptly combined as in the human mouth; and yet there is none where the structure is so simple.

The mouth, with all these uses, is but a single cavity, one machine, with its parts neither crowded nor confused, and each unembarrassed by the rest.

If we cannot eat and sing at the same moment we can eat one moment and sing the next, the breathing proceeding freely all the while.

There is one case, however, of this double office which the mouth alone could not perform, and that is, carrying on together the two actions of sucking and breathing, which is absolutely necessary for an infant.

Another way, therefore, is opened for the air, namely through the nose, which lets the breath pass backward and forward, whilst the lips of the child, in the act of sucking, are necessarily shut close upon

the breast from which the nourishment is drawn.

It is a circumstance worthy of notice, that the nose would have been necessary for this purpose, even if it had not been the organ of smelling.

The making it the seat of a sense was giving it a new use, but the part was already wanted for this other purpose, namely to allow the possibility of an infant being fed.

The number of muscles which must work together, in order that we should be able to breathe, is very great. Physicians reckon up a hundred muscles that are employed every time we take in our breath, yet we take in or let out our breath, without reflecting what a work is thereby performed—what an apparatus of instruments we are provided with for the service, and how many must contribute their assistance to enable us to breathe.

Breathing with ease is a blessing of every moment, yet of all others, it is that which we possess with the least consciousness. A man in an asthma is the only one who knows how to estimate it.

Let us consider the muscles a little further.

Mr. Home has observed, that the most important and the most delicate actions are performed in the body by the smallest muscles, and he mentions, as his examples, the muscles which have been discovered in the eye and in the ear.

The smallness of these muscles is astonishing. They are so much finer than hairs, that they must be looked at through a magnifying glass in order to be seen at all; yet are they real effective muscles, and not only such, but the grandest and most precious of our faculties, namely, our sight and hearing, depend upon their health and action.

What contrivance can be more wonderful than the following, namely, a slit in one muscle to let another muscle pass through it? This structure is found in the muscles which move the toes and fingers. The long muscle or tendon, as it is called, in the foot, which bends the first joint of the toe, passes through the short tendon which bends the second joint, which course allows to the muscle more liberty, and a more commodious action, than it would otherwise have been capable of exerting.

There is nothing in the belts or straps of a cotton-mill that more evidently shows

design than the passing of the one muscle through a hole in the other.

The next circumstance to mention is, if possible, a still more decisive mark of intention than the other, and that is, the tendons which pass from the leg to the foot being bound down by a ligament or band at the ancle.

The foot is placed at a considerable angle with the leg; it is manifest, therefore, that flexible strings passing along the interior of the angle, if left to themselves, would, when stretched, start up from it; the obvious means of prevention, therefore, is to tie them down.

And this is done in fact; for across the interior, rather just above it, the anatomist finds a strong ligament or band, under which the tendons pass to the foot. The effect of the ligament, as a bandage, can be made evident to the senses, for if it be cut, the tendons start up, as they might be expected to do if it was not there.

The simplicity, yet the clearness of this contrivance, and its exact resemblance to established recources of art, place it amongst the most undoubted instances of design with which we are acquainted.

Let us now consider the blood.

The disposition of the blood vessels is like that of the water pipes in a city, namely, large and main trunks branching off by smaller pipes, (and these again by still narrower tubes,) in every direction, and towards every part in which the fluid can be wanted.

So far, the water pipes which serve a town may represent the vessels which carry the blood from the heart.

But there is another thing necessary to the blood which is not wanted for the water, and that is, the carrying of it back again to its source.

For this office, a reversed set of vessels is prepared, which are united at their extremities with the extremities of the first set, and collect from them the divided streamlets into branches, and these branches are again collected into trunks, and through them, the blood is returned to the fountain whence its motion proceeded, namely, to the heart.

The body thus contains two sets of blood vessels. The arteries which send the blood out from the heart, and the veins which carry the blood back to it.

The blood in going out passes always from wider into narrower tubes, and in

coming back, it passes from narrower into wider; the arteries which carry out the blood are formed of much rougher and stronger coats than the veins which bring it back.

And therefore it is, that in the arteries, by reason of the greater force by which the blood is urged along them, a wound or rupture would be more dangerous than in the veins.

Now we find that the arteries are defended from injury, not only by their texture but by their situation, and by every advantage of situation which can be given to them.

Sometimes they creep along groves made for them in the bones: for instance, the under edge of the ribs is sloped and furrowed, as if solely for the passage of these vessels.

Sometimes they proceed in channels protected by stout parapets of bone or muscle on each side, which last description is remarkable in the bones of the fingers, they being hollowed out in the underside, like a scoop, in such a manner that the finger may be cut across to the bone without hurting the artery which runs along it.

In other instances, the arteries pass in canals, which are in the very middle of the substance of the bone; this takes place in the lower jaw.

All this care is wonderful, yet not more than the importance of the case requires.

To those who venture their lives in a ship, it has been often said that there is only an inch board between them and death, but in the body itself, especially in the system of arteries, there is, in many parts, only a film or a thread.

For which reason, the arteries lie deep under the skin, whereas the veins, in which the mischief that ensues from injuring the coat is much less, lie in general above the arteries, they come nearer to the surface, and are more exposed.

The next thing to be considered is the engine which works this machinery of the blood vessels, namely, the heart.

There is found in the central part of the body a hollow muscle, called the heart, bedded in strong fibres.

By the contraction of these fibres, the sides of the heart are necessarily squeezed together, so as to force out the blood which it contained; and again, by the relaxation of the same fibres, the cavity is

in its turn dilated, and of course prepared to admit the blood when poured back into it by the veins.

This is a general account of the apparatus, and the simplest idea of its action is, that by each contraction of the heart a portion of blood is forced, by a sort of syringe, into the arteries, and at each dilatation of the heart, an equal portion is received back into it from the veins.

This produces, at every stroke, a motion and change in the mass of blood, equal to the amount of what the heart contains, which, in the heart of a full grown person, is about an ounce, or two table spoonsful.

We may, any of us, feel this beating of the heart, and also the pulse at our wrists; they move exactly together and depend upon the same cause; they are each of them the action of squirting the blood through the arteries.

The heart contracts about four thousand times in one hour; from which it follows, that there passes through the heart, every hour, four thousand ounces of blood. Now the whole mass of blood is said to be about twenty-five pounds, or three hundred ounces, so that a quantity equal to the whole mass of blood passes through the

heart fourteen times in one hour, which is about once every four minutes.

Consider what an affair this is when we come to very large animals.

The great artery of a whale is larger in the bore than the main pipe of the water works at London bridge; and the water roaring in its passage through that pipe, is inferior in force and velocity to the blood gushing from the whale's heart.

The heart performs this office in conjunction with another office of equal curiosity and importance: it is necessary that the blood should be continually brought into contact with the air.

So that the air, by some means or other, must be introduced into a near communication with the blood.

The lungs of animals are constructed for this purpose; they consist of blood vessels and air vessels lying close to each other.

The internal surface of these vessels in the lungs is so great, that, if collected and spread out, they would be, in a man, equal to a surface of fifteen square feet.

As soon as the blood is received by the heart from the veins, and before it is sent out again into its arteries, it is carried by

the contraction of the heart to the lungs, and made to enter their air vessels, from which, after it has been aired, it is brought by a large vein once more to the heart, to be thence distributed anew into the arteries.

"The wisdom of the Creator," saith Bamburgher, "is in nothing seen more gloriously than in the heart;" and how well doth it execute its office!

An anatomist, who understood the structure of the heart, might say, beforehand, that it would play, but he would naturally expect from the complexity of its mechanism, and the delicacy of many of its parts, that it would always be liable to derangement, or that it would soon wear itself out.

Yet, does this wonderful machine go night and day, and often for eighty years, at the rate of a hundred thousand strokes every twenty-four hours, having at every stroke resistance to overcome, and it continues this action, for this length of time, without disorder, and without weariness.

Here, also, we cannot consider but with gratitude, how happy it is that our vital motions are involuntary.

We should have enough to do if we had to keep our hearts beating, and our stomachs at work.

If these things depended upon our own care and attention, they would not leave us leisure for any thing else. We must have been continually upon the watch, and continually in fear: nor would this constitution have allowed us ever to sleep.

It might, perhaps, be expected, that an organ so precious as the heart should be defended by a case.

The fact is, that a purse or bag, made of strong tough materials, is provided for it, holding the heart within its cavity, sitting loosely and easily about it, guarding its substance, without confining its motion, and containing likewise, a spoonful or less of water, just sufficient to keep the surface of the heart in a state of suppleness and moisture.

Does not the enclosing of the heart in a sack, which answers no other purpose but that enclosure, show the care and design that has been taken of its preservation?

The blood is constantly supplying materials for the spittle, perspiration, and tears, the wax in the ear, and other secretions.

On the other hand, the blood is constantly supplied and renewed by our food; the manner in which this is effected is well worthy our attention.

The food descends by a wide passage into the intestines; undergoing a preparation on its way, by being chewed and moistened in the mouth.

Can it be doubted, with what design the teeth were placed in the road to the stomach, or that there was a choice of a wise Creator, in fixing them in this situation.

The teeth are admirably fitted for their office; some of them are sharp, as those in the front, for separating the food; others are broad and flat, for the purpose of bruising it.

Let us also take occasion to admire the goodness and wisdom of the Almighty, in furnishing each animal with the teeth best fitted for the food in which the animal takes delight.

To those animals, which live upon soft food, teeth for cutting would be useless; and, therefore, they are without them.

But those which live upon the flesh of their prey, are furnished with cutting

teeth, for the purpose of tearing it asunder. Whilst man, who consumes not only animal, but vegetable food, is provided with both.

After the food has got into the stomach, it there is further prepared by what is called digestion.

The figure and position of the stomach, are calculated for detaining the food long enough for the action of its gastric juice, which is the liquid provided there to effect digestion.

The stomach has the shape of the pouch of a pag-pipe; and, what is very curious, the passage by which the food leaves it, is somewhat higher up than the passage by which it enters; so that it is by the contraction of the muscular coat of the stomach, that the contents, after having undergone the application of the gastric juice, are gradually pressed out.

The gastric juice is so powerful, that upon an experiment which was made, a quarter of an ounce of beef had scarcely touched the stomach of a crow, when it began to be dissolved.

Digestion is not putrefaction: for the digesting fluid resists putrefaction most effectually.

Nor is it a fermentation: for the solution begins at the surface, and proceeds to the center, contrary to the order in which fermentation acts and spreads.

Nor is it effected by the action of heat: for the cold maw of a cod will dissolve the shells of crabs or lobsters, harder than the sides of the cod's stomach, which contain them.

The gastric juice of a hawk or kite will not affect grain; no, not even to finish the half digested seeds, which are left in the crops of the sparrows that the bird devours.

The reason of that is, that grain is not intended for the food of hawks or kites.

But the grain is speedily dissolved by the gastric juice of poultry, because grain was intended for their food.

For the same reason the gastric juice of the sheep and the ox speedily dissolves vegetables; but makes no impression upon beef, mutton, and other animal bodies, though the gastric juice of animals, which live on flesh, will at once, as has been said before of the crow, produce the solution.

Doctor Hunter discovered a property of this fluid of a most curious kind; namely,

that in the stomachs of animals which feed upon flesh, though this fluid acts irresistably upon animal substances when dead, it will not operate upon living substances at all.

The flesh of any thing that has life in it suffers no injury from the gastric juice; worms and insects are found alive in the stomach of many animals, and the coats of the human stomach in a healthy state, are not injured by the gastric juice which they contain.

Yet in cases of sudden death it has been known to eat a hole through the bowel which contains it.

How nice is this discrimination, and yet how necessary.

The food having been thus converted into pulp, by the gastric juice in the stomach, passes into the guts; and, though lately consisting of various kinds of meats, fruits, and vegetables, it is reduced to one uniform substance, fitted for yielding its essence called chyle, which is a liquor resembling milk more than any other liquor with which it can be compared.

The intestines or guts form a canal of no less than thirty-six feet in length; but

they are so carefully folded up as to go into a small compass.

Throughout the course of their whole length, their inside coat is covered with the mouths of millions of small pipes, far smaller then hairs.

These pipes or tubes, which are so fine and slender as scarcely to be visible, branch off from every part of the intestines, and have their other ends united in a bag, of size sufficient to hold about two table spoon fulls; in this bag the chyle is collected.

From this vessel a main pipe proceeds, climbing up to the back part of the chest, and afterwards creeping along the gullet till it reaches the neck, and there it discharges itself into a large vein, which conveys the chyle flowing along with the blood into the heart.

The whole road of the chyle can be exhibited to the eye; nothing is left to be supplied by imagination or conjecture.

Now we may remark the extraordinary length of the intestines, which in a man is six times that of the body.

These long bowels seem in no wise necessary, merely for a passage; but in order to allow time and space for the

extraction of the chyle from the digested food.

So that the chyle which escapes from being taken up in one part of the guts, may be taken up in another.

The length of the canal is of evident use for this purpose.

It was necessary that these tubes which take up the chyle, or their mouths at least, should be made as narrow as possible, in order to prevent the admission into the blood of any particle, large enough to make a lodgment afterwards in the small arteries, and thereby to obstruct the circulation.

And it was also necessary that this extreme fineness of the tubes should be compensated by their number, for a large quantity of chyle, not less than two or three quarts in a day, is by some means or other to be passed through them.

Accordingly, we find the number of these chyle tubes, exceeding all power of computation.

The chyle enters the blood in an odd place, but perhaps the most commodious possible; namely, at a large vein in the neck, so situated with respect to the circulation, as speedily to bring the chyle and blood mixed together to the heart.

Who could have dreamt of a communication from the inside of the guts, to the great vein of the neck?

Who could have suspected that this very comunication should be the contrivance by which all nourishment is conveyed to the body; or this the place, where, by a side inlet, the important mixture is formed between the blood and the chyle which feeds it?

It was remarked once by a person, who knew the anatomy of the human figure, that every time a man lifts his hand to his head, he has cause to admire the power and wisdom of the Almighty.

And this was well said, for he has only to reflect, how many things are requisite for the performing of this action, familiar and simple as it seems to be.

First, he must have a long, hard tube of a bone, in order to give to the arm its firmness; but which being rigid, and its substance inflexible, can only turn upon joints.

Secondly, he must have joints for this purpose: one at the shoulder to raise the arm, another at the elbow to bend it. These joints continually fed with a soft

oil to make the parts slip easily upon one another, and held together by strong braces to keep them in their position.

Then strings and muscles for the purpose of drawing the bones in the directions in which the joints allow them to move.

A farther provision is still necessary; namely, a communication with the brain, by means of nerves.

We know the existence of this communication, because we can see the communicating threads, and can trace them to the brain.

If we consider the body of any animal, we cannot forget to notice what a number of instruments are brought together, and often within how small a compass.

It is a cluster of contrivances.

In a Goldfinch, for instance, and in the single ounce of matter which composes its body, we have instruments for eating, for digesting, for nourishment, for breathing, for singing, for running, for flying, for seeing, for hearing, for smelling, each entirely different from all the rest.

A farther proof of the care and design of our Creator, is the exact correspondence of the two sides of the same animal, the right hand answering to the left, leg to leg,

eye to eye, one side of the countenance to the other.

In a picture or statue this forms one of the greatest difficulties of the artist, and requires a constant attention to this property of his work distinct from every other.

It is a very difficult thing to get a wig made even; yet how very seldom do we see the human face made crooked?

The exact resemblance of the two eyes to each other, is a property much to be admired, considering how various and delicate are the shades of colour with which they are tinged; how variously the eye may be mounted in its socket; and how different in different heads, eyes are actually set.

From amongst ten thousand eyes it would perhaps be impossible to match one, except with its own fellow, or to distribute them into suitable pairs by any other selection than that which actually exists.

Another perfection of the body is the manner in which it is packed, nothing seems more suprising.

Examine the contents of the body of any large animal.

Take notice how soft, how tender, how intricate, these contents are; how con-

stantly in action, how necessary to life; reflect upon the danger of any injury to their substance, or any derangement to their position, or any obstruction to their office.

Observe the heart panting at the center, at the rate of four thousand strokes in an hour; observe one set of pipes, namely, the arteries, conveying the stream of blood away from it; another set, namely, the veins, bringing the blood back again.

Observe the lungs performing their nice office; namely, stretching and contracting their many thousand vessels, in a manner which cannot cease for a minute, without causing death.

Observe the stomach exercising its powerful actions; the bowels propelling the digested food, whilst the most minute vessels opening out upon their inner surface, are collecting from it as it proceeds, and are sending to the blood an incessant supply of prepared nourishment, called chyle.

Observe that blood pursuing its incessant round, while the liver, the kidneys, and many other organs, are drawing off from it all the while their proper secretions.

All these several operations, together with others more subtile, but less capable

of being investigated, are going on within us at one and the same time.

Think of this and then observe, how the body itself, which is the case which holds this machinery, is rolled and jolted, and tossed about; the mechanism remaining unhurt, and with very little molestation, even of its nicest motions.

Observe a rope-dancer, a tumbler, or a monkey, the sudden twistings, and jerks, and shakings, which the internal parts must sustain, by the postures into which their bodies are thrown; and observe the shocks which these parts often receive in yourselves, from sudden falls and bruises without receiving much damage.

Observe this, and then reflect, how firmly every part must be secured; how carefully defended, how well tied down, and packed together.

CHAP. II.

Let us now consider the property of animal beauty.

That is to say, the provision which is made in the body of almost every animal,

to adapt its appearance to the tastes of the animals with which it has to do.

In our own species for example, only consider what the parts and materials are, of which the fairest body is composed, and no further observation will be necessary, to show how well those things are wrapped up, so as to form a mass which shall be capable of symmetry in its proportions, and of beauty in its appearance.

How firm and strong and light the bones are, how admirably they are covered, the bowels concealed, the roughness of the muscles smoothed and softened; and how over the whole is drawn a covering of fair flesh and skin, which instead of the disgusting materials of a dissecting-room, produces an object of pleasure to the sight.

All this is the work of an infinitely wise God.

In plants, and especially in the flowers of plants, the principle of beauty holds a still more distinguished place.

Why, for instance, does the flower of a tulip, when advanced to its size and maturity, assume such splended colours? The purposes of vegetable life, so far as we can see, might have been carried on as well by its continuing green.

The skin or covering of animals, is that upon which their appearance chiefly depends, and it is that part which perhaps in all animals is most decorated, and most free from impurities.

But were beauty entirely out of the question, there is still another purpose answered by this covering, which is of far greater importance, and that purpose is concealment.

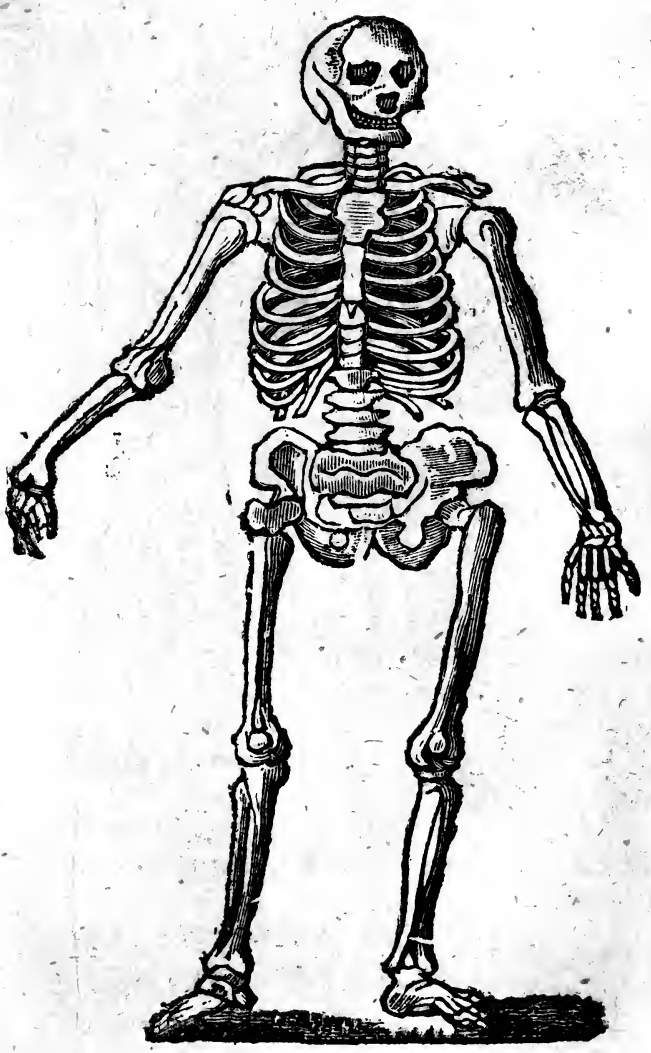
Were it possible to view the mechanism of our bodies, the sight would strike us with terror.

For we durst not make a single movement, or stir a step from the place we were in, if we saw our own blood circulating, the tendons pulling, the lungs blowing, the humours filtrating, and all the incomprehensible assemblage of fibres, tubes, pumps, valves, currents, and pivots, which sustain our life.

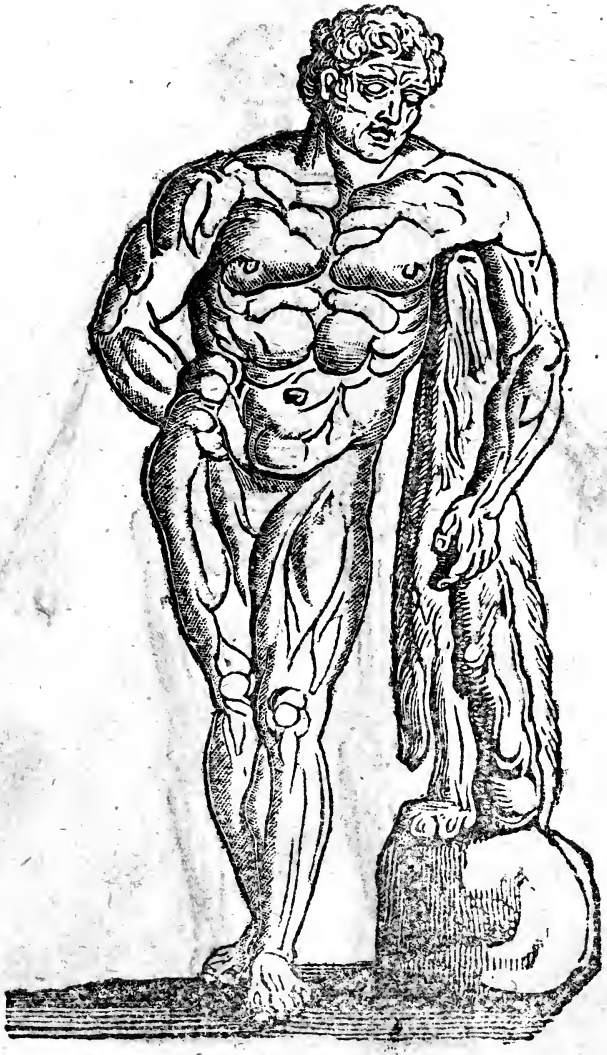
Let us now consider animals as compared with each other.

There exists between all large terrestrial animals a great degree of general resemblance.

In them all, life is sustained, and the body nourished, by nearly the same contrivances.



THE SKELETON.



THE HUMAN FIGURE.

The heart, the lungs, the stomach, the liver, the kidneys, are much alike in all; the same fluid (for no distinction of blood has been observed) circulates through their vessels, and nearly in the same order.

The covering of different animals is the first thing which presents itself to our observation, and in truth, both for its variety, and its suitableness to their several natures, is as much to be admired as any part of their structure.

We have bristles, wool, furs, feathers, quills, prickles, yet in this diversity both of material and form, we cannot change one animal's coat for another, without evidently changing it for the worse.

The human animal is the only one which is naked, but then it is the only one which can clothe itself.

This is one of the properties which renders man an animal of all climates, and of all seasons, and which was necessary for him, as he is to inhabit every part of the earth.

For thus he can adapt the warmth or lightness of his covering to the temperature of his habitation.

Had man been born with a fleece upon

his back, although he might have been comforted by its warmth in very cold countries, it would have become intolerably oppressive for those who lived in the torrid zone.

What art however does for man, Providence has in many instances done for those animals which are incapable of art.

Their clothing changes, by the wise provision of the Being who created them, with their necessities.

This is particularly the case with that large tribe of quadrupeds covered with furs.

Every dealer in hare-skins, and rabbit-skins, knows how much the fur is thickened by the approach of winter.

It is also a further illustration of the Creator's wisdom and goodness, that wool, happily for the animals, degenerates in hot countries into hair.

Whilst, on the contrary, hair is turned into wool, or something very like it in the dogs of the polar regions.

The cause of this is most deserving of our admiration, hair is cooler as a covering than wool; and, therefore, it is found in those countries where the weather is intensely hot. Wool, on the other hand, being the warmer, Providence gives it as a

clothing for animals in those countries where additional warmth is necessary.

To which we may add, that bears, wolves, foxes, hares, which don't take the water, have the fur much thicker on the back, than on the belly, whereas in the beaver, and other animals fond of swimming, it is thickest upon the belly.

The reason of this is most illustrative of God's care and goodness in the animals that pass much time in the water, the belly being most exposed to the cold, has the warmest covering; whereas in animals that live on land, the additional warmth of clothing is given to the back, that being most in want of it.

The covering of birds cannot escape the attention of the most careless observer; it's lightness, its smoothness, its warmth, the disposition of the feathers all inclined backward, the down about their stems, the over-lapping of their tips, their different forms, not to mention the variety of their colours, constitute a vestment for the body so beautiful, and so appropriate to the life which the animal is to lead, that we should in all probability, have had no conception of any thing equally perfect, if we had

never seen it, nor can we now imagine any thing more perfect.

Let us suppose a person who had never seen a bird, to be presented with a plucked pheasant, and bid to set his wits to work how to contrive for it a covering, which should unite the qualities of warmth, lightness, and the least possible resistance to the air; giving it also, as much of beauty and ornament as he could afford.

After all his blundering trials, he would be the person most fitted to behold the work of the Deity in this part of His creation, with the sentiments which are due to it.

In comparing different animals there is no part of their structure which exhibits greater variety, or a nicer accommodation to their different wants, than that which is seen in the form of their mouths.

In the human species, forasmuch as there are hands to convey the food to the mouth, the mouth is flat, and fitted only for receiving the food. But the dog has projecting jaws and pointed teeth, such as fit him for snatching, and seizing the objects of his prey.

The full lips, the rough tongue, and the broad cutting-teeth of the ox and the deer, the horse and the sheep, qualify them for browsing on the pasture, either gathering large mouthfuls at once, where the grass is long, or biting close where it is short, which the horse and the sheep are able to do in a degree that one could hardly expect.

The retired under-jaw of a swine, works in the ground, after the projecting snout like a sprong or prough has made its way to the roots upon which it feeds.

Could any other form be better calculated for the animal, or for the manner in which it obtains its food in a wild state.

In birds, the mouth assumes a new character, new both in substance and in form; but in both wonderfully adapted to the wants and uses of their mode of life.

We have no longer the fleshy lips, the teeth of enamelled bone; but we have in place of them, and fitted to perform the office of both, a hard substance; namely, the bill, cut out into proper shapes, and mechanically suited to the actions which are wanted.

The sharp edge and tempered point of the sparrow's bill picks almost every kind

of seed from its concealment in the plant, and not only so, but hulls the grain, and breaks and shatters the coats of the seed, in order to get at the kernel.

The hooked beak of the hawk tribe, separates the flesh from the bones of the animals which it feeds upon, almost with the cleanness and precision of a dissecter's knife.

The spoon-shaped bill of a goose enables it to graze, to collect its food from the bottom of pools, or to seek it amidst the soft or liquid substances with which it is mixed.

The long tapering bill of the snipe and wood-cock, penetrates still deeper into moist earth, which is the bed in which the food of that species is lodged; this is exactly the sort of instrument which the animal wanted.

It did not want strength in its bill, which was inconsistent with the slender form of the animal's neck; as well as unnecessary for the kind of food upon which it subsists.

But it wanted length to reach its object, and length was accordingly given to it.

And what is most extraordinary of all, in some kind of animals which change

their form, one sort of mouth, as the occasion requires, is changed into another sort.

The catterpillar lives only upon vegetable food; and is, therefore, furnished with teeth for the purpose of biting the leaves which it devours.

When it becomes a winged insect, its food changes to the honey which is found in the honey-cup of flowers; teeth would be therefore useless, and accordingly it has instead of teeth, a long trunk, to pump it up from its retreat.

Whilst the insect can only creep, it has the means of gathering the food fitted for it, namely, teeth; but when it obtains wings, it is enabled to gather that food, to which it then possesses the means of flying.

Amid these novelties of form, we sometimes forget that it is all the while the mouth of the same individual; whether it be lips, or teeth, or bill, or beak, or shears, or pump, it is the same part changed in its form.

It is also remarkable, that under all the varieties of shape with which we are acquainted, and which are very great, the organs of taste and smelling are situated, near each other.

Another subject of comparison between animals is in their instruments of motion; these come before us under three divisions: feet, wings, and fins; let any one say whether they are not all equally fitted for their use, or whether the same consummate wisdom is not conspicuous in them all.

The elements in which the motion is to be performed, are very different. The nature of animal motions, must, therefore, necessarily conform to that difference.

The Creator, if we might so speak, had to prepare for different situations, and for different difficulties; yet the purpose is accomplished with equal success in all cases,

And it is accomplished without deserting the general resemblance between wings and the corresponding limbs of quadrupeds.

Strip a wing of its feathers, and it bears no small resemblance to the fore-leg of a quadruped. The joints at the shoulder and the elbow are much alike, and what is a closer circumstance of resemblance, in both cases the upper part of the limb consists of a single bone, the lower part of two.

The steerage of a bird in its flight, is affected partly by the wings, but still more by the tail; and herein we meet with a circumstance not a little remarkable. Birds with long legs have short tails, and they are mostly such birds as wade, to whom long tails would be an incumbrance.

Such birds in their flight, place their legs close to their bodies, and at the same time stretch them out backwards as far as they can. In this position the legs extend beyond the rump, and become the rudder, supplying that steerage which the tail could not.

Look at the next crane or heron that you see, and you will perceive this to be the case. Indeed in those birds when they are on the wing, the legs are often mistaken for a tail.

Observe now the web-foot of water-fowl; the usefulness of the web to water-fowl, and its uselessness to land-fowl, are so obvious, that it seems impossible to notice the difference without acknowledging how kindly the Almighty has fitted each for its peculiar life, as before mentioned.

The ears of beasts of prey, of lions, tigers, wolves, have their trumpet part, or hollow, standing forwards, to seize the sounds which are before them; that is, the sounds of the animals which they pursue or watch.

But the ears of animals of flight, for instance, the hare and the deer, are turned backward, to receive notice of the approach of their enemy from behind, as it is from thence he might steal upon them unseen.

We may remark a circumstance in the structure of the claws of certain birds; the middle claw of the heron and cormorant, is toothed and notched like a saw; these birds are great fishers, and these notches assist them in holding their slippery prey; the use is evident.

The gannet, or soland goose, has the side of its bill irregularly jagged, that it may hold its prey the faster, and the reason why no such provision was annexed to the claws, is this, that the feet are employed in swimming.

A more distinguishing instance of the care of Providence, can hardly be imagined, than the providing of things before

hand, which are not to be used until a considerable time afterwards.

The human teeth afford an instance, not only of this contrivance with regard to the future, but further, of the completion of the contrivance being designedly suspended, until the moment when it was wanted.

For they are formed within the gums, and there they stop; the fact being, that their farther advance to maturity, would not only be useless to the new born animal, but extremely in its way, as it is evident that the act of sucking, by which it is for some time to be nourished, will be performed with more ease both to the nurse and to the infant, whilst the inside of the mouth, and the edges of the gums, are smooth and soft, than if set with hard pointed bones.

But the teeth are ready for use, by the time they are wanted for more substantial food, and also for speech.

They have been lodged within the gums for some months past, but detained as it were in their sockets, so long as their further growth would interfere with the office to which the mouth is then designed.

Our Maker looked beyond the first year of the infant's life; yet, whilst he was providing for functions which were after that term to become necessary, he was careful not to incommode those which preceded them.

What renders it more evident that this is the effect of design, is, that the teeth are born imperfect, whilst all other parts of the mouth are perfect.

The lips are perfect, the tongue is perfect, the cheek, the jaws, the palate, are all perfect when a child is born; the teeth alone are not so.

The parts above enumerated are called into use from the beginning, whereas the teeth would be only so many obstacles and annoyances, if they were there.

Thus it is with respect to the human mouth.

When a contrary order is necessary, a contrary order prevails. In the worm of the beetle as hatched from the egg, the teeth are the very first things which arrive at perfection, for the insect is obliged to begin to gnaw as soon as it escapes from the shell, though its other parts are only gradually advancing to their maturity.

What has been observed of the teeth, is true of the horns of animals, and for the same reason, the horn of a calf or lamb, does not bud until the animal is quite capable of browsing upon its pasture; because such a substance upon the forehead of the young animal, would very much incommode the teat of the dam, in the office of giving suck.

It is not easy to conceive a more evident contrivance for the future, than that which is found in the milk of the female parent. At the moment the young animal enters the world, there is its maintenance ready for it.

The particulars to be remarked in this are neither few, nor unimportant; we have first, the nutritious quality of the fluid, unlike, in this respect, every other secretion of the body.

Nature hitherto remains unimitated in this, neither cookery nor chemistry having been able to make milk out of grass.

The production of milk is a constant wonder; and it adds to other causes of our admiration, that the number of the teats or paps in each species, is found to bear a proportion to the number of the young.

In the sow, the bitch, the rabbit, the

cat, the rat, which have numerous litters, the paps are numerous, and are disposed along the whole length of the belly; but in the cow and mare, they are few, because they have but a single young one.

Another instance of provision for the future, may be seen in the lungs.

Considering the state in which an animal exists before its birth, shut up in the parent's womb without air, and not needing it, we should look for any thing in its body, rather than a system of lungs. It is like finding a pair of bellows in the bottom of the sea.

Of no sort of use in the situation which they are found, because air cannot reach them, formed for an action which was impossible to be exerted, holding no relation to the element which surrounds them, but to another element in another place.

Another striking instance of the care of Providence, is in the remedies which it provides for the peculiar wants of some animals.

At the corner of a bat's wing there is a bent claw, in the form of a hook, by which the bat attaches itself to the sides of rocks, caves, and buildings, laying hold

of crevices, joinings, chinks, and roughnesses. It holds itself by this claw, remains suspended by this hold, and takes its flight from this position, all which operations compensate for the weakness of its legs and feet.

The bat without her hook, would be the most helpless of all animals. She can neither run upon her feet, nor raise herself from the ground, but these inabilities are made up to her, by the contrivance in her wing, and by placing a claw on that part.

The crane kind are destined to live and seek their food amongst the waters; yet having no web-feet, are incapable of swimming. To make up for this deficiency, they are furnished with long legs for wading, and long bills for groping for their prey.

Not only is the surface of deep waters peopled by numerous tribes of birds that swim, but marshes and shallow pools are furnished with hardly less numerous tribes of birds that wade.

The spider lives upon flies, but has no wings to pursue them; this would have been very necessary to the spider, but if she trusted to her legs would have been a very hopeless attempt. The wants of the

spider are, therefore, provided for by a resource which no stratagem, no effort of the animal could have produced, the power of spinning a web. This it fastens like a net in those situations where it is most likely to intercept flies, its proper food.

The works of the Deity, are distinguished by expedients. Wherever we can see a want, some contrivance always comes in to meet the difficulty.

It will explain this better to say, that the Almighty having given to each species, a different form, where he denies wings to one, or feet to the other, provides in place of those, something that is better adapted to the animal's nature.

A snail, with neither wings or feet, nor the power of spinning like a spider, climbs up the stalks of plants, by the sole aid of a sticky humour discharged from her skin, and adheres to the stems, leaves, and fruits of plants, by means of a sort of sticking plaster.

A muscle, which might seem by its helplessness to be at the mercy of every wave that goes over it, has the singular power of spinning strong threads by which she moors her shell to rocks and timbers.

A cockle, on the contrary, by means of a stiff tongue, works for itself a shelter in the sand. The care of Providence extends to cases apparently the most desperate.

A lobster has in its constitution a difficulty so great, that one could hardly conjecture before hand how nature would meet it.

In most animals the skin grows with their growth. If, instead of a soft skin, there be a shell, still it may in most cases admit a gradual enlargement.

Thus, as the animal grows larger, for instance, the tortoise, the additional substance is made at the joinings of the large scales.

Oyster-shells grow larger by an addition at their edge, it is the same with periwinkles at their mouth, the simplicity of their form admits of this.

But as the lobster-shell grows quite round the limbs, as well as round the body of the lobster, it allows not of any of the modes of growth which are observed to take place in the other shells; its hardness prevents it from stretching, and its complexity renders it incapable of increasing its size, by addition of substance to its edge.

How then was the growth of the lobster to be provided for, was room to be made for it in the old shell, or was it to be successively fitted with new ones?

If a change of shell became necessary, how was the lobster to extricate himself from his present confinement, how was he to uncase his buckler, or draw his legs out of his boots?

The process which fishermen have observed to take place, is as follows:

At certain seasons, the shell of the lobster grows soft, the animal swells his body, the seams open, and the claws burst at the joints, when the shell has thus become soft upon the body, the animal makes a second effort, and by a convulsive shaking, casts it off.

In this state, the liberated, but defenceless fish, retires into holes in the rocks. The released body now suddenly pushes its growth.

In about eight and forty hours, a new shell is formed, fitted in every part to the increased size of the animal. This wonderful change is repeated every year.

A very numerous tribe of land animals are entirely without feet, yet have as much

occasion to move as others; serpents and worms for instance; how is the want of feet to be compensated in them?

They are enabled to move by the disposition of the muscles and fibres of the body.

By means of the joint action of rings and strings, the bodies of serpents, worms, and various reptiles are capable of being shortened and lengthened, drawn up and stretched out. The result of this action is a forward motion, and in some cases a very rapid one of the whole body, in any one direction to which the will of the animal determines it.

The meanest creature is a collection of wonders. Observe the play of the rings in an earth-worm as it crawls, the waving motion of its body, the beards or prickles, with which it is armed; and which the animal can either shut up close to its body, or let out to lay hold of the roughness of the surface upon which it creeps.

Let us consider further how admirably the bodies of animals are fitted for the elements by which they are surrounded, and in which they move; how excellently, for instance, are the wings of birds adapted

for their motion through the air, and how equally well the fins of fish for proceeding through the water.

Can it be doubted whether the wings of birds bear a relation to air, and the fins of fish to water.

They are instruments of motion, severally suited to each element.

Was not the nature of water contemplated when fins were given to fish, and the nature of air referred to, when birds were provided with wings.

Throughout the universe there is a wonderful proportioning of one thing to another, the size of one animal to another, and of the human animal, especially, when considered with respect to other animals, and to the plants which grow around him.

It is exactly such as a regard to his convenience would have pointed out.

A giant could not have milked goats, reaped corn, or mowed grass; he could not have rode a horse, or trained a vine, or shorn a sheep.

A pigmy would have been lost among rushes, or carried off by birds of prey.

Take the earth as it is, and consider the correspondence of the powers of its inhabitants, with the properties and condition of the soil which they tread; take the inhabitants as they are, and consider the substances which the earth yields for their use, they can scratch its surface, and its surface supplies all which they want.

When we pass from the earth to the sea, from land to water, we pass through a great change; but we find a corresponding change of animal forms, and functions, and of animal capacities and wants, suited to the new element.

The earth in its nature is very different from the sea, and the sea from the earth; but one accords with its inhabitants, as exactly as the other.

Can it be doubted that it is in consequence of the special appointment of our Creator, that animals cherish their offspring, that the young quadruped is directed to the teat of its dam, that birds build their nests, and brood with so much patience upon their eggs, that insects which do not sit upon their eggs, deposit them n those particular situations, in which the young, when hatched, find their appropriate

food, and that salmon, and some other fish, go from the sea into rivers, for the purpose of shedding their spawn in fresh water.

Let us consider more particularly, out of this catalogue, one of the most familiar instances, the hatching of eggs.

There can be no doubt, but that a couple of sparrows, hatched in an oven and kept separate from the rest of their species, would proceed as other sparrows do, in every office, which related to the production or preservation of their brood.

The thing is inexplicable upon any other supposition than that of instinct, impressed upon the constitution of the animal, by its Creator.

For first, what should induce the female bird to prepare a nest before she lays her egg; it is in vain to suppose her to be possessed of the faculty of reasoning, for no reasoning will reach the cause.

For let us suppose the egg to be produced, how should birds then know that their eggs contain their young?

There is nothing either in the appearance, or in the contents of an egg, which could lead even the most daring imagina-

tion, to conjecture, that it was hereafter to turn out from under its shell, a living perfect bird.

The form of the egg bears no mark of resemblance to that of the bird, and even if we break it, we find less reason, if possible, to suspect for what it was intended.

If we should go so far, as to guess that it might be designed for the abode and nourishment of an animal, we should expect a tadpole dabbling in the slime, much rather, than a dry, winged, feathered creature.

From the white of an egg, would any one look for the feather of a goldfinch, or expect from its simple uniform substance one of the most complicated of all machines, a bird.

But admit the sparrow by some means to know, that within that egg was concealed the beginnings of a future bird, from whence was she to learn that warmth was necessary to bring it to maturity, or that the degree of warmth imparted by her own body, was the degree required.

Of young birds taken in their nests, and which are from their earliest infancy, necessarily separated from their parents and the

rest of their kind, some afterwards breed in cages, and they are still found to build their nests nearly in the same manner as in the wild state, and to sit upon their eggs.

In the case of moths, and butterflies, their practices are still less likely to be the effects of education, than those of birds.

These deposit their eggs in the precise substance, that of a cabbage for example, from which, not the butterfly herself, but the caterpillar which is to issue from her eggs, draws its food.

The butterfly cannot taste the cabbage, cabbage is no food for her.

Yet, it is not by chance but by a careful choice, she lays her eggs in the cabbage.

There are amongst many other kinds, the willow caterpillar, and the cabbage caterpillar, but we never find upon a willow, the caterpillar which eats the cabbage.

This choice of the butterfly, cannot proceed from instruction, she had no teacher.

In her caterpillar state, she never knew her parent.

A self-hatched caterpillar, she came out of an egg, before she was turned into a butterfly; the egg had been laid long

before by a butterfly, which deserted it as soon as it was laid, and died before it was hatched.

No knowledge, therefore, can be handed down amongst butterflies, from one generation to another.

There is no opportunity amongst them, either for instruction or imitation; the parent race is gone before the new brood is brought forth.

And if it be reasoning in the butterfly, it is profound reasoning indeed; for she must remember her caterpillar state, and then foresee, that the little egg, which drops from herself, will, at a future period, produce a living creature, not like herself, but like the caterpillar, which she remembers herself once to have been.

In birds is it the egg which the hen loves? or is it the expectation which she cherishes of a future progeny, that keeps her upon her nest?

What cause has she to expect delight from her progeny?

Can any rational answer be given to the question, why prior to her experience, the brooding hen should look for pleasure from her chickens?

The taste has been given to her by her Maker; no other answer can be given.

It does not appear that the cuckoo ever knows her young, yet, in her way, she is as careful in making provision for them as any other bird.

She does not leave her egg in every hole.

The salmon suffers no obstacle to oppose her progress up the stream of fresh rivers; she struggles through the rapids, she leaps up the cascades.

And what does she do when she gets up the stream? she sheds a spawn, which she immediately quits, in order to return to the sea, and this issue of her body she never afterwards acknowledges in any shape whatever.

Where shall we find a motive for her efforts, and her perseverance, except in the designs and order of our Creator?

The violet crab of Jamaica performs a fatiguing march of some months continuance, from the mountains to the sea side. When she reaches the coast, she casts her spawn into the open sea, and sets out upon her return home.

Moths and butterflies, as we have already observed, seek out for their eggs those

precise situations and substances which the caterpillars, which are to be produced from their eggs, will find to be their proper food.

But that dear caterpillar the parent butterfly must never see; and there are no experiments to prove, that she would retain any knowledge of it, if she were to see it.

How shall we account for her conduct, her art and judgment, in choosing out and securing a maintenance for her young, and still more for the impulse upon which she acts?

What should induce her to exert any art, or judgment, or choice, about the matter?

The undisclosed grub, the animal which she is destined not to know, can hardly be the object of a particular affection.

How shall we account for that strong affection which a hen bears to her chickens, ceasing altogether when they grow up?

Birds and beasts, after a certain time banish their offspring, disown their acquaintance, and seem to have even no knowledge of the objects which so lately

engrossed the attention of their mind, and occupied the industry and labour of their bodies.

This change in different animals takes place at different distances of time from the birth, but the time always corresponds with the ability of the young animal to maintain itself.

In the sparrow tribe, when it is perceived that the young brood can fly, and shift for themselves, then the parents forsake them for ever, and though they continue to live together, pay them no more attention than they do to other birds in the same flock.

And yet how fond of them they were; how did they caress them, with their affectionate notes, and lull and quiet them with their tender parental voice, and put food into their mouths, and cherish and keep them warm, and teach them to pick and gather food for themselves, and, in a word, perform the part of so many nurses, deputed by the Sovereign Preserver of the world, to assist such young and helpless creatures.

Neither ought it, under this head to be forgotten, how much this care costs the animal that feels it; how much a bird, for

example, gives up by sitting upon her nest, how repugnant it is to all her habits and her pleasures.

An animal formed for liberty submits to confinement, in the very season when every thing invites her abroad.

An animal delighting in motion, made for motion, all whose motions are so easy and so free, and which is hardly a moment at other times at rest, is, for many hours of many days together, fixed to her nest, as close as if her limbs were tied down by pins and wires.

It is surely impossible to see a bird in that situation, without recognizing an invisible hand detaining the contented prisoner from her fields and groves for a purpose, as the event proves, most worthy of the sacrifice, most important, most beneficial.

But the loss of liberty is not the whole of what the bird suffers; Harvey tells us, that he has often found the female wasted to the skin and bone, by sitting upon her eggs.

My young friends, remember that the bird and you had one and the same Maker: what He has so carefully and benevolently

provided, do not you in wantonness or cruelty destroy; spare the poor mother and her young ones for each other.

The structure and the use of the parts of insects are less understood than that of quadrupeds and birds, not only by reason of their smallness, but also on account of the remoteness of their manners, and modes of life, from those of larger animals.

Observe the wings of a beetle; the true wings of the animal is a light transparent skin, finer than the finest gauze, and not unlike it; it is also, when expanded, very large in proportion to the size of the animal.

In order to protect this delicate wing, a strong horny case is given to it, which lies over it when the animal is at rest.

When the animal is at rest, the gauze wings lie folded up under this impenetrable shield; when the beetle prepares for flying, he raises the covering, and spreads out this thin membrane to the air.

And it cannot be observed, without admiration, what a tissue of cordage, made of the finest muscles, must run along this fine surface, in order to enable the animal, either to gather it up whenever it desires

to place its wings under their shelter, or to expand again their folds, when wanted for flying.

Many or most of the beetle species lodge in holes in the earth, and have frequently to squeeze their way through narrow passages, in which situation wings so tender and so large could scarcely escape injury, without both a firm covering to defend them, and the power of collecting themselves up under its protection.

Another contrivance, equally denoting the care of Providence, is the awl, or borer, fixed at the tails of various species of flies, and with which they pierce in some cases plants, in others wood, in others the skin and flesh of animals, and in others even lime, mortar, and stone, in order to deposit their eggs in the hole.

The stings of insects are in their shape not unlike this piercer; the sharpness to which the point in all of them is wrought, the temper and firmness of the substance of which it is composed, the strength of the muscles by which it is darted out, compared with the smallness and weakness of the insect, and with the soft texture of the rest of the body, are properties of the sting to be noticed and not a little to be admired.

The sting of a bee will pierce a strong glove, it penetrates the human flesh more readily than the finest point of a needle.

The action of the sting affords an example of the union of chemistry and mechanics, combined for the little creature's defence.

First, as to the chemistry, how strong must be the venom which, in so small a quantity, can produce such powerful effects.

And in the bee we may observe, that this venom is made from honey, the only food of the insect, but the last material from which it would naturally have been expected, that a strong poison could have been prepared, by any process or digestion whatsoever.

In the next place, with respect to the mechanism, the sting is not a simple, but a compound instrument. The visible sting, though drawn to a point exquisitely sharp, is in strictness only a sheath, for near to the extremity may be perceived, by the microscope, two small holes, from which, after the point of the main sting has buried itself in the flesh, are launched out two still more subtile piercers, which may be

called the true or proper stings, being those through which the poison is infused into the puncture, already made by the outer sting.

Chemistry and mechanism are here united, and it was necessary; for all this machinery would have been useless, and the little piercers would scarcely be felt by us, if a supply of poison had not been furnished from the insect's body.

And, on the other hand, the poison could not have attained its effects, or reached its enemy, if, when it was collected at the extremity of the insect, it had not found there a machinery fitted to conduct it to the external situations in which it was to operate.

We have here an awl to bore a hole, and a syringe to inject the fluid.

The trunk with which many insects are endowed comes next in order to be considered; it is a tube or pipe attached to the head of the animal.

In the bee it is composed of two pieces, connected by a joint; for if it were constantly extended, it would be too much exposed to accidental injuries.

Therefore, when it is not in use, it is

doubled up by means of the joint, and in that position lies secured under a scaly penthouse.

In many species of the butterfly, the proboscis or trunk, when not in use, is coiled up like a watch-spring.

In the bee the proboscis serves the office of the mouth, the insect having no other, and it is evident how much better it is fitted than a mouth would be, for the collecting of the proper nourishment of the animal.

For the food of the bee is the nectar of flowers, a drop of syrup lodged deep in the bottom of the flower; the bee thrusts his long narrow pump into these cells, and sucks up this precious fluid, inaccessible to every other approach.

It is observable also, that the plant is not the worse for what the bee has done to it; the harmless plunderer rifles the sweets, but leaves the flower uninjured.

The ringlets of which the trunk of the bee is composed, and the muscles by which it is extended and contracted, form so many wonders when seen through a microscope.

The agility also with which it is moved, can hardly fail to excite admiration.

The change of form in insects, from grubs to moths, and flies, is an astonishing process; a hairy caterpillar is transformed into a butterfly.

We have four beautiful wings where we had none before, a trunk in the place of a mouth with jaws and teeth, and six long legs instead of fourteen feet.

In another case, we see a white, smooth, soft worm turned into a black, hard, horny beetle, with gauze wings.

This an astonishing process; in what manner is it performed?

It seems most probable, that there exist at the same time three animals, one within another, all nourished by the same digestion, and having a circulation of the blood common to them all: the latest discoveries and experiments seem to favour this supposition.

In the butterfly species, the insect, already equipped with wings can be discovered under the skin of the worm, which covers it as with a case. In some species, the trunk, the feelers, the limbs, and wings of the fly have been observed to be folded up, within the body of the caterpillar, with the greatest nicety.

This being so, the outermost animal, which, besides having its own proper character, serves as a covering to the other, dies, as we suppose, and drops off first.

What we call the chrysalis, or husk, then offers itself to observation; this also has a sort of languid life, and in its turn dies; its brittle husk falls to pieces, and finally makes way for the appearance of the butterfly, which springs from the filth that surrounds it, and rises on its wings into a new element, full of life, and joy, and beauty, with new habits, new pursuits, and new enjoyments, and a new and unknown world all before it.

Let this wonder of the insect world remind us of the resurrection of the human body.

"Why should it be thought with you a thing incredible, that God should raise the dead?" was a question put by the apostle to the learned of the heathen world.

Had they duly reflected on the caterpillar crawling at their feet, they need not have considered it incredible.

But we have a better warrant for the truth, we know it from Divine Revelation, which tells us, that this corruptible body must put on incorruption, and this mortal must put on immortality.

The time will come, we know, when the soul and body of which we are composed, must part.

The body will then be placed in the grave, and must return to the dust from which it was made; but the soul never dies; it shakes off its clay, and rises into a new stage of being.

The insect throws off its outer covering, and the crawling caterpillar becomes an inhabitant of the air; it flies about from place to place, but it is only to perform the purpose intended by the Almighty. It lays its eggs and dies.

But when the soul throws off its case, it becomes meet for eternity—it never dies—it lives for ever, either in happiness or misery.

It is religion tells us this. Religion also tells us how we may hope to be blessed in Heaven—and by what conduct, also, we shall earn the punishment of Hell.

We now return to the insects.—Almost all insects are produced from eggs. Nature keeps her butterflies, moths, and caterpillars locked up during the winter in their egg state.

And we have to admire the various devices resorted to for the security of the egg.

Many insects enclose their eggs in a silken web—others cover them with a coat of hair torn from their own bodies,—some glue them together, and others, like the moth and the silk worm, glue them to the leaves of trees, upon which they are laid, that they may not be shaken off by the wind, or washed away by the rain.

Some again cut holes in the leaves, and hide an egg in each hole, while others wrap their eggs up in a soft substance, which forms the first food for the young animal when it comes forth into life; and others again make a hole in the earth, and having stored it with a quantity of proper food, deposit their eggs in it.

In all which we are to observe, that the expedient depends not merely upon the address of the animal, but also that its own constitution provides it with the means.

The art also with which the young insect is coiled up in the egg presents, where it can be examined, a subject of great curiosity.

The insect, furnished with all the members which it ought to have, is rolled up into a form which seems to contract it into the least possible space.

By which contraction, notwithstanding the smallness of the egg, it has room enough in its apartment, and to spare.

This folding up of the limbs, appears to indicate a special direction of Providence; for if it were merely the effect of compression, the position of the parts would be more various than it is. In the same species it is always the same.

No person who has inspected a bee-hive can forbear remarking, how commodiously the honey is bestowed in the comb; and amongst other advantages, how effectually the fermentation of the honey is prevented by distributing it into separate small cells.

The fact is, that when the honey is separated from the comb, and put into jars, it runs into fermentation, with a much less degree of heat than that which takes place in a hive.

What could the bee do with the honey if it had not the wax—how could it store it up for winter.

The bee finds the honey, but makes the wax.

The honey is lodged in the bottoms of flowers, and probably undergoes little alteration—it is merely collected.

Whereas, the wax is a paste made out of dry powder, not simply by kneading it with a liquid, but by a digestive process in the body of the bee.

What account can be rendered of these facts, but that the animal, being intended to feed upon honey, was, by its all-wise Creator, provided with a form of mouth to procure it.

Moreover, wanting the honey in the season of winter when it could not be procured at all—it was farther endued with the no less necessary faculty of constructing waxen store-houses for its preservation.

The sting also of the bee has this relation to the honey, that it is necessary for the protection of a treasure which invites so many robbers.

Europe has lately been surprised by the elevation of bodies in the air by means of a balloon. The discovery consisted in finding out a manageable substance which was, bulk for bulk, lighter than common air.

And the application of the discovery was to make a body, composed of this substance, bear up along with its own

weight, some heavier body which was attached to it,—the two bodies together being, however, lighter than the same bulk of common air.

This expedient, so new to us, proves to be no other than that which the Author of nature has employed in the gossamer spider. We frequently see this spider's thread floating in the air, and extended from hedge to hedge, across a road or brook of four or five yards in width.

The animal which forms the thread has no wings wherewith to fly from one extremity to the other of this line, nor muscles to enable it to spring or dart to so great a distance. Yet, its Creator has laid for it a path through the air. And after this manner, though the animal itself be heavier than air, the thread which it spins from its bowels is lighter. This is its balloon.

The gossamer spider, left to itself, would drop to the ground, but being tied to its thread, both are supported.

We have here a very peculiar provision, and to a contemplative eye, it is a most gratifying spectacle to see this insect wafted on her thread, sustained by a lightness

not her own, and traversing regions which, if we examined only the body of the animal might seem to have been forbidden to its nature.

The shells of snails are a wonderful and most singular contrivance.

Other animals have their winter quarters to retreat to,—but the snail carries these about him. He travels with his tent upon his back, and this tent, though it is both light and thin, is completely secured from moisture and from air.

The young snail comes out of its egg with the shell upon its back, and the gradual enlargement which the shell receives, is derived from the slimesecreted by the animal's skin.

The will of the animal could not determine the quality of the secretion.

Add to this, that the shell of a snail, with its pillar and its twisted chamber, is a very artificial fabric, whilst a snail, as it should seem, is the most numb and unprovided of all artificers.

In the midst of variety, there is likewise a regularity which would hardly be expected. In the same species of snail, the number of turns is usually, if not always the same.

The sealing up of the mouth of the shell is also well calculated for its warmth and security; but the door is not of the same substance with the shell.

The shell of a lobster's tail, by its overlappings and joints, represents a coat of mail; or rather a coat of mail is an imitation of a lobster's shell.

The same end is to be answered by both; namely, self defence: the same properties, therefore, are required in both; namely, hardness and flexibility — a covering which may guard the part without hindering its motion.

For this double purpose, the art of man expressly exercised upon the subject, has not been able to devise any thing better than what nature presents to his observation in the lobster.

And how clumsy is the armour made by man, compared to that with which Providence has furnished the fish.

But to return to insects; it is in this class of animals above all others, especially when we take in the multitude of species, which the microscope discovers, that we are struck with what has been called the insatiable variety of nature.

There are said to be six thousand species of flies, and seven hundred and sixty butterflies, each different from the rest.

Mr. St. Pierre tells us, from his own observation, that thirty-seven different kinds of winged insects visited a single strawberry plant in the course of three weeks.

Ray observed, within the compass of a mile or two of his own house, two hundred kinds of butterflies.

In the vast variety of animal forms, we are sometimes led to take notice of the different methods by which one and the same end is attained.

In breathing, for example, insects in general do not breathe by the mouths, but in various other manners.

The young of gnats have an apparatus to raise themselves to the top of the water, and so take breath by their backs.

The water beetles do the like by thrusting their tails out of the water.

A certain kind of maggot has a long tail, one part sheathed within another, (but which it can draw out at pleasure,) with a starry tuft at the end, by which

tuft, when expanded upon the surface, the insect both supports itself in the water, and draws in the air which is necessary.

In the article of natural clothing, we have the skins of animals invested with scales, hair, feathers, mucus, froth, shell, or crust, providentially given to fit each for the place it fills in the creation.

In the no less necessary article of offence and defence, we have teeth, talons, beaks, horns, stings, prickles, and in one species of fish, we have a singular expedient for the same purpose, the power of giving the electric shock.

The torpedo, or electrical eel, when it pursues its prey, has the power of striking it with a numbness, like that caused by an electric shock, which deprives it of all power of flight or resistance.

The same property is also used by the animal as a means of defence against its enemies:—for when a person attempts to handle one which has been caught, he receives through both his arms an electrical stroke, which completely deprives him of the power of moving them.

And some animals have the power of driving away their pursuers by an intolerable stink, or of blackening the water, through which they are pursued.

To this great variety in living creatures the Deity has given a corresponding variety of animal appetites.

For the end and objects of this we have not far to seek.

If all animals were to covet the same elements, retreat, or food, it is evident how much fewer could be supplied and accommodated than what at present live conveniently together, and find a plentiful subsistence.

What one nature rejects, another delights in; food which is nauseous to one tribe of animals, becomes, by that very property which makes it nauseous, an alluring dainty to another tribe.

Carrion is a treat to dogs, ravens and vultures. The exhalations of corrupted substances attract flies by crowds; maggots delight in putrefaction.

CHAP. III.

We should never think of the elements without reflecting upon the number of distinct uses which are united in the same substance.

The air supplies the lungs, supports fire, conveys sound, reflects light, diffuses smells, gives rain, wafts ships, bears up birds.

Water, besides maintaining its own inhabitants, is the universal nourisher of plants, and through them of land animals, is the basis of their juices and fluids, dilutes their food, quenches their thirst, floats their burdens, and dissolves or melts a great many solid bodies.

Fire warms, dissolves, and enlightens, and is the great promoter of vegetation, and of life.

Air is rendered unfit for the support of animal life by breathing, by fire, and by putrefaction. By the constant operation of these corrupting principles, the whole atmosphere, if there were no restoring causes, would come at length to be deprived of its necessary degree of purity.

Some of these restoring causes have been discovered; and so far as the dicovery has

proceeded, it opens to us a beautiful and a wonderful provision.

Vegetation proves to be one of them; a sprig of mint corked up in a bottle with a small portion of foul air, placed in the light, renders the air again capable of supporting life or flame.

Here, therefore, is a constant circulation of benefits maintained between the two great provinces of organised nature. The plant purifies what the animal has poisoned.

In return, the contaminated air is more than ordinarily nutritious to the plant.

Agitation with water turns out to be another of these restoratives. The foulest air shaken in a bottle with water for a sufficient length of time recovers a great degree of its purity.

Here then we see the salutary effects of storms and tempests.

The tumbling waves which often rise so high, are doing the very thing which was done in the bottle.

Nothing can be of greater importance to living creatures than the wholesomeness of their atmosphere.

It ought to give us, therefore, a more correct view of these agitations of the elements, of which we sometimes deplore the consequence, to know that they tend powerfully to restore to the air that purity which so many causes are constantly imparing.

In water there is also an excellence which cannot be sufficiently admired; that is, its want of taste.

Had it been like wine, or oil, or vinegar; had the sea been filled, or the rivers flowed with beer, or milk, or spirits, fish constituted as they are, must have died. Plants, constituted as they are, would have withered,—the animals which fed upon plants, must have perished.

Now, it is the want of taste in water which renders it the best of all substances for our use.

Having no taste of its own, it becomes the clear and perfect carrier of every other taste.

Had there been a taste in water, be it what it might, it would have infected every thing with which it was mixed, with a troublesome repetition of the same flavour.

Another thing in this element not less to be admired, is the constant round which it travels, and by which, without suffering either waste or mixture with any thing that could spoil it, it is continually offering itself to the wants of the habitable globe.

From the sea the sun's heat causes those vapours to arise which form the clouds. These clouds descend in rain.

Rain penetrating into the crevices of the hills, supplies springs.

Springs flow in little streams into the valleys, and these streams uniting become rivers.

Which rivers, in return, feed the ocean, from which ocean the same water rises once more in vapour to form the clouds again.

So there is an incessant circulation of the same fluid, and probably not one drop more or less now, than there was at the creation of the world.

A particle of water takes its departure from the surface of the sea, in order to fulfil certain important offices to the earth, and having executed the service which was assigned to it, returns to the bosom which it left.

Some have thought that we have too much water upon the globe, the sea occupying above three quarters of its whole surface.

But the expanse of ocean, immense as it is, may be no more than sufficient to fertilize the earth, by ascending into the air to become rain.

Or independently of this reason, why may not the sea have as good a right to its place as the land? It may proportionably support as many inhabitants, and be as large a source of enjoyment.

The land affords only a habitable surface; the sea is habitable to a great depth.

Water appears to a common observer to be one of the simplest of all substances. Yet in reality it consists of two substances joined together, and each of them perfectly unlike that water which they form by their union.

This has been discovered by chemistry, which has added greatly to human knowledge, and which more than most sciences, brings us acquainted with the admirable care and design of our Creator, in the formation of the materials of our globe.

Who would suppose pure water to be composed of the mixture of two kinds of air, and nothing else?

And who would suppose that one of those airs was the great supporter of fire and every kind of burning.—And that the other of these airs was one of the most inflammable substances we know?

The first of these airs is called vital air, and the other inflammable air. Who would have supposed that it is by burning these two airs together, that water, of all things, is produced?

Who would have supposed that a man could have raised himself above the clouds?

And if we had been assured of its possibility, who would have suspected that it was by means of a little common water that it could be done? Yet so it is.

For it is this inflammable air that is put into a balloon; the balloon when filled with it, is so light, that it rises in the air for the same reason that a cork rises when placed at the bottom of a pool.

The inflammable air is about twelve times lighter than the air which we breathe. It is quite unfit for breathing, and any living creature that was put into it would die.

If any fire touches this inflammable air, it will explode like gunpowder.

It is often produced in great quantities from the water in caves and deep mines, and is called by the workmen the fire-damp.

Dreadful accidents have sometimes taken place by its exploding in mines where workmen have gone in with torches.

It has killed the miners, and sometimes shot them and all the machinery out into the air.

A chemist can separate any certain quantity of water into these two airs of which it is formed.

And he can then weigh these two airs.

And he can then join these two airs again by burning them together, and the result is, that they produce the same quantity and weight of water as at first.

The air which we breathe is also far from being one uniform substance; it is a very curious mixture of two kinds of air.

The first of these is the same vital air of which you have just heard.

The next is by chemists called azote: about one-fourth of the air which we breathe is vital air, and the remaining three-fourths are azote.

It is by means of the vital air that it serves both for our breathing and for fire burning in it.

No animal could live in azote—nor would fire burn in it, but the union of these two airs forms exactly that sort of air which is most fitted for the maintenance of animal life.

It is a curious consideration that when these two airs are united in another manner they produce aqua-fortis, a liquid which possesses such violent powers that it burns up our flesh as fire would do, and dissolves copper as water would dissolve salt.

We will mention only one other kind of air, which miners call the choke-damp, which is often found in great quantities in mines.

It is heavier than any of the airs which we have mentioned, and, therefore, rests upon the bottom of the mine. No fire will burn in it, and no animal can breathe in it. Many persons have lost their lives by getting into it.

It is this sort of air which is often found in the bottom of deep wells. Many pump-borers have been killed by it.

When a man gets into it he faints in an instant, and dies in a very few seconds unless drawn out of it.

The best course to take with such an unfortunate person is, to dip him immediately in cold water. And the best way of removing choke-damp from wells or caves where it is found, is to pour into it a quantity of water.

We meet with the last mentioned air in places where we should least expect it.

It is produced in great quantities in the brewing of beer, and would often prove fatal to the workmen, but that they take proper precautions against it.

It is also contained, in still greater quantities, in substances which common observation would never lead us to suspect had any thing to do with it. For instance, in many sorts of stone.

Limestone contains it in great abundance.

And it is this air which makes limestone so good a manure. When we burn limestone, we produce no other change than that we take this air out of it.

Quick-lime is nothing else than limestone deprived of this air.

And limestone is nothing else than pure lime with this air united to it.

This air is principally composed of a substance called carbon, which is the nourisher of all plants.

It is, therefore, that the substances which contain this air are such good manures.

We meet with this air united to lime in other substances besides common limestone.

All shells are made of it.—We may consider shells as the richest and purest of all limestone.

It is, therefore, that sea-sand is a good manure; it is good just in proportion as it contains broken shells.

Hot lime has this curious property, that by long exposure to common air it becomes united again to the air of which we have been speaking.

For the common air contains a very small proportion of the choke-damp, and the lime attracts this portion to itself.

When the hot lime has thus again been united to the choke-damp, it loses its acrid

quality, and becomes limestone as it was before.

Only that it remains in the very small particles, into which it was separated by being burnt.

And chemists well know that it is in this second state that lime is most powerful as a manure, and not in its hot state—though few common farmers are of this opinion.

It would require a very large volume to detail all the extraordinary discoveries that chemists have made about the different kinds of air.

But thus much may suffice to give some faint idea of the wonderful arrangements of our Creator amongst what appear to be such simple substances.

It is altogether superfluous to expatiate on the use of Light.

No man disputes it; the observations, therefore, which are here offered, respects the little which we know of its nature.

Light travels from the sun, at the rate of twelve millions of miles in a minute; urged with such a quickness, with what force must its particles drive against every substance, animate or inanimate, which stands in its way; and especially against

the eyes, the tenderest of all animal substances?

It might seem to be a force sufficient to shatter to atoms the hardest bodies.

How then is this consequence of such prodigious velocity guarded against? By a proportionable minuteness of the particles of which light is composed.

It is impossible for the human mind to imagine to itself any thing so small as a particle of light.

But this extreme smallness, though difficult to conceive, is easily proved. A drop of tallow expended in the wick of a farthing candle, shall send forth rays sufficient to fill a space of a mile in breadth, and to fill it so full of these rays, that an aperture not larger than the pupil of an eye, whereever it be placed within that space, shall be sure to receive some of them.

What floods of light must continually be poured from the sun!

The closeness of the sun's rays at the earth, is such, that the number which falls upon a burning glass of an inch in breadth, is sufficient, when collected to a point, to set wood on fire.

The smallness and velocity of particles of light may be said to be proportioned to

each other, both surpassing our utmost stretch of comprehension. And it is this proportion alone which converts a tremendous element into a welcome visitor.

When the multitude of animals upon the earth, and in the waters, and in the air, is considered, we cannot reflect without the profoundest adoration upon the character of that Being from whom all these things have proceeded.

We cannot help acknowledging what a manifestation of benevolence Creation was; of a benevolence how minute in its care, how vast in its comprehension.

The world was made with a benevolent design; nor is the design abortive; it is a happy world after all.

The air, the earth, the water, teem with delighted creatures.

In a spring noon, or summer evening, on whichever side we turn our eyes, myriads of happy beings crowd upon our view.

"The insect youth are on the wing. Swarms of new born flies are trying their pinions in the air. Their sportive motions their wanton mazes, their continual change of place, apparently without use or purpose

testify their joy, and the exultation which they feel in their lately discovered faculties.

A bee amongst the flowers in spring is one of the most cheerful objects that can be looked upon. Its life appears to be all enjoyment, so busy and so pleased.

Yet it is only a specimen of insect life, with which, by reason of the animal being domesticated, we happen to be better acquainted than we are with that of others.

The whole tribe of winged insects, it is probable, are equally intent upon their proper employments, and under every variety of their constitution, equally gratified by the offices which the Great Author of their being has assigned to them.

But the atmosphere is not the only scene of enjoyment for the insect race. Plants are covered with countless varieties greedily sucking their juices.

It cannot be doubted but this is a state of gratification: what else would fix them so close to the operation, and so long?

Other species are running about, with an alacrity in their motions, which carries with it every mark of pleasure; large patches of ground are sometimes covered with these brisk and sprightly creatures.

If we look to what the waters produce, shoals of the fry of fish frequent the margins of rivers, of lakes, and of the sea itself.

These are so happy that they know not what to do with themselves. Their attitudes, their vivacity, their leaps out of the water, their frolics in it, all concur to show their excess of spirits, and are simply the effect of that excess.

In watching by the sea-side in a calm evening, upon a sandy shore, and with an ebbing tide, you might frequently remark the appearance of a dark cloud, or rather very thick mist, hanging over the edge of the water, to the height, perhaps, of half a yard, and of the breadth of two or three yards, stretching along the coast as far as the eye could reach, and always retiring with the water.

When this cloud comes to be examined, it proves to be nothing else than so much space filled with young shrimps, in the act of bounding into the air from the shallow margin of the water, or from the wet sand.

If any motion of a mute animal can express delight, it is this; if they had meant to make signs of their happiness,

they could not have done it more intelligibly.

Suppose, then, what there is no doubt of, each individual of this number to be in a state of enjoyment, what a scene of gratification and pleasure have we here before our view.

Animal enjoyments are infinitely various.

The modes of life to which the habits of different animals respectively direct them, are not only of various but of opposite kinds; yet each is happy in its own way.

For instance, animals of prey, as the hawk or the fox, live much alone; animals of a milder disposition, live in society.

Yet the herrings which swim in shoals, and the sheep which graze in flocks, are not more happy in a crowd, or more contented amongst their companions, than is the pike or the lion in the deep solitudes of the pool or the forest.

At this moment, how many myriads of animals are eating their food, gratifying their appetites, resting in their holes, accomplishing their wishes, pursuing their pleasures, taking their pastimes.

In each individual animal, how many things must go right for it to be at ease, yet how large a proportion out of every species is so in every instant of time.

The young of all animals appear to receive positive pleasure, simply from the exercise of their limbs, without reference to any end to be answered by the exertion.

A child, without knowing any thing of the use of language, is in a high degree delighted with being able to speak. Its incessant repetition of a few articulate sounds, or perhaps of the single word which it has learned to pronounce, proves this point clearly.

Nor is it less pleased with its first successful endeavours to walk, although entirely ignorant of the importance of the attainment to its future life, and even without applying it to any purpose.

A child is delighted with speaking, without having any thing to say, and with walking, without knowing where to go.

And prior to both these, many are disposed to believe that the waking hours of infancy, are agreeably taken up with the exercise of their sight; or perhaps more properly speaking with learning to see.

But it is not for youth alone that the Great Parent of creation has provided. Happiness is found with the purring cat, no less than with the playful kitten. In the arm-chair of peaceful age, as well as in the sprightliness of youth.

In saying this of old age and youth, it is only with reference to the pleasure that rest gives the body, when the limbs are infirm, and the happiness that the young derive from motion, when the limbs are strong and active.

For an old man cannot be happy, if he has passed his life in wickedness. Nor a young man experience the enjoyment of which we have been speaking, if conscience tells him that he is mispending his time, and acting wrong.

Herein, then, is the difference between the young and the old: the former is happy when enjoying the pleasures of motion, the latter is happy when at rest and free from pain.

And this constitution suits with the degrees of animal power, which they respectively possess. The vigour of youth is stimulated to action by impatience of rest, whilst to the imbecility of age, quietness and repose become positive gratifications.

This same feeling and relish for ease, often renders old age a condition of great comfort, especially when riding at its anchor after a busy or tempestuous life.

It is well described to be the interval of repose and enjoyment, between the hurry and the end of life.

The appearance of satisfaction with which most animals seek and enjoy rest, after their labours, affords reason to believe, that this source of gratification is appointed to advanced life, in their natures as well as in our own.

In the species with which we are best acquainted, namely, our own, it does not seem that youth is its happiest season, much less the only happy one.

We believe that there is a great deal of truth in the following representation, given by a very pious writer as well as an excellent man.

" To the intelligent and virtuous, old age presents a scene of tranquil enjoyments, of obedient appetites, of well regulated affections, of maturity in knowledge, and of calm preparation for immortality.

" In this serene and dignified state, placed as it were on the confines of two worlds, the mind of a good man reviews what is past, and looks forward with humble confidence in the mercy of God, and with devout aspirations towards his eternal favour.

CHAP. IV.

In the human species, the prevalence of good over evil, of health, for example, and ease over pain and distress, is proved by the degree of notice which calamities excite.

What inquiries does the sickness of our friends produce! How much conversation is excited by their misfortunes!

This shows that the common course of things is in favour of happiness; that happiness is the general rule, and misery the exception from it.

Were the order reversed, our attention would be called to examples of health and competency, instead of disease and want.

It is a most important observation that the pains and miseries which man meets with in this world, are, in truth, chiefly the work of man himself.

And that the misfortunes which men experience so often in life, are mostly chargeable upon themselves.

How much human misery is caused by war! How many thousands does a great battle deprive of parents, or brothers, or sons, or friends!

How much do the inhabitants suffer in those countries which are the seat of war!

Now all this misery could be prevented, if men were disposed to love each his neighbour as himself.

"Love your enemies," said our blessed Lord and Saviour "do good to them that hate you, pray for them that despitefully use you, and persecute you; that you may be the children of your Father, which is in Heaven."

Again,—sickness it must be confessed, is a great scourge of the human race, and yet, let us consider, how much of it is produced by our own vices.

Let us observe the drunkard or the glutton—he enfeebles his body by excess, he brings on some incurable disease, and if he

has a family, he transmits his own sickly constitution to his children.

To take another instance, every one is ready to acknowledge that the number of those who suffer poverty is very great. Few, however, reflect how much poverty is produced by man himself.

Many a one marries, before he has wherewithal to support a wife and family. Is it at all surprising in such a case, that this should cause him to be always in distress?

Many a one has a good trade, but he is not industrious; can any one wonder that such a man should be very poor?

Another has a good shop and a ready sale for his goods, but his customers leave him and go elsewhere, either because he is uncivil, or he seeks too large a profit, or he strives to get high prices for inferior articles. Is he not himself to blame that the world goes wrong with him?

Look at some of the beggars who ask for alms in the public roads and streets—they are able enough to work. What makes them so ragged and squalid? They are lazy and unwilling to work—they had rather get a penny by begging, than earn

five pence by labour. Is it not natural they should suffer for their habits?

"When we were with you," says Saint Paul, "this we commanded you, that if any would not work, neither should he eat."

In fact, the more we should consider the subject, the plainer it would appear, that the greater part of the misery which is witnessed in life, is caused by man himself.

When God created the world, the Scripture tells us, that "He saw every thing that he had made, and behold it was very good."

But the sin of man soon changed this happy state, and brought pain and misery and death into the world.

The heart of man became deceitful and desperately wicked.

Hatred, variance, wrath, strife, seditions, envying, murder, drunkenness are amongst, the works of our fallen nature, as enumerated by the Apostle.

And how large a share of the miseries of this world springs from their fruitful source.

But the incomprehensible goodness of God has provided the means of rescuing us from sin and death.

By His inestimable love in the redemption of the world by our Lord Jesus Christ.

But the design of this volume does not permit that we should pursue that subject further.

For the plan of this work is rather to consider the visible things of creation.

And to avoid every discussion which could interfere with the religious tenets of any denomination of Christians; and the consideration of the scheme of man's redemption, might lead us too far into such discussions.

We shall, therefore, say no more of revealed religion, than to press upon your minds, how immeasurably more important it is, than all the knowledge which the survey of the outward creation can impart.

To the views of that Creation we now return.

One great cause of our insensibility to the goodness of the Creator, is the very extensiveness of His bounty. We prize but little what we share only in common with the rest, or with the generality of our species.

When we hear of blessings, we are apt to think forthwith of successes, of prosperous fortunes, of honours, riches, preferments, that is of advantages and superiorities over others. And thus the common benefits of our nature often entirely escape us; yet these are the great benefits after all.

These constitute what most properly ought to be accounted the blessings of Providence. Nightly rest, and daily bread, the ordinary use of their limbs and senses and understandings, are gifts which admit of no comparison with any other; they are so much the most valuable.

Yet because almost every man we meet with, possesses these, we are apt to leave them out of our reckoning; they raise no sentiment, they move no gratitude.

Now in this, our judgment is perverted by our selfishness. A blessing ought in truth, to be the more satisfactory, and the bounty of the Giver rendered more conspicuous, by its very commonness; and by its falling to the lot, and forming the happiness of the great bulk and body of our species as well as of ourselves.

Nay, even when we do not possess it, it ought to be matter of thankfulness that others do.

If our Maker had wished our misery, He might have made sure of his purpose by forming our senses to be so many sores and pains to us, instead of being as they are now, instruments of gratification and enjoyment, or He might have placed us amidst objects so ill-suited to our perceptions as to have continually offended us, instead of serving for our refreshment and delight.

He might have made, for example, every thing we tasted bitter, every thing we saw loathsome, every thing we touched a sting, every smell a stench, and every sound a harsh noise.

We see the world abounds with contrivances, but we should remember that all the contrivances which we are acquainted with, are directed to beneficial purposes.

Evil, no doubt exists, but is never (as far as we can perceive) the object of contrivance.

In describing implements of husbandry, you would hardly say of the sickle, that

it was made to cut the reaper's hand, though from the construction of the instrument, and the manner of using it, this mischief often follows.

We never discover a train of contrivances to bring about an evil purpose.

No anatomist ever discovered a system of organization calculated to produce pain and disease; or in explaining the parts of the human body, ever said, this is to irritate, this to inflame, this channel is to convey the gravel to the kidneys, this gland to produce the humour which causes the gout.

With respect to venomous bites and stings, it may be observed, that so far as the animal itself is regarded, the faculty complained of is a good, being conducive either to its defence, or to the subduing of its natural prey.

And in some instances, it conduces to the killing of the prey when caught, by a mortal wound inflicted in the passage to the stomach, which may be no less merciful to the victim than salutary to the devourer.

In the viper, for instance, the poisonous fang may do that which in other animals

of prey is done by the crush of the teeth. Frogs and mice might be swallowed alive without it.

It has been very justly remarked, concerning serpents, that whilst only a few species, in fact, possess the venomous property, that property has the effect of guarding the whole tribe.

The most harmless snake is avoided with as much care as a viper.

Now the terror with which large animals regard this class of reptiles is its protection, and this terror is founded on the formidable injury which only a few of the number are capable of inflicting.

The species of serpents described by Linnæus amounts to 218, of which 32 only are poisonous.

But part of the mischief which man complains of from ferocious or poisonous animals is, in fact, attributable to himself.

Man leaves large and fertile countries without a human inhabitant, and invades burning sands and deserts, which may be considered as the territories of venomous reptiles and wild beasts, and then complains, that he is infested by their bites and stings.

Some accounts of Africa place this observation in a strong point of view: "The "deserts in the South of Africa," says Adanson, "are entirely barren, except "where they are found to produce serpents, "and these in such quantities, that some "extensive plains are almost covered with "them."

These are the creatures appropriated to such a situation; let them enjoy their existence, let them have their country.

Surface enough will be left to man, though his numbers were increased a hundred fold; and it will be left to him in countries where he may live exempt from these annoyances.

Again, if we consider the great end that is answered by the disposition that certain animals have to prey upon each other, we shall find that what at first sight appears to be an evil, is by infinite wisdom made to fulfil a wise and beneficent purpose in the economy of nature.

Now to judge whether, as a general provision, this can be deemed an evil, the following reflections are fit to be attended to.

Immortality upon this earth is out of

the question; without death there could be no generation, no parental relation.

The natural age of different animals varies from a single day to a century of years. No account can be given of this, nor could any be given, even though other proportions of life had obtained amongst them.

The length then of life in different animals being the same as it is, the question is, what mode of taking it away is the best, even for the animal itself?

Now, according to the established order of nature, the three methods by which life is usually put an end to are, acute diseases, decay, and violence.

The simple and natural life of brutes is not often visited by acute distempers, nor could it be deemed an improvement of their lot, if it were.

Let it be considered, therefore, in what a condition of suffering and misery a brute animal is placed, which is left to perish by decay.

In human sickness or infirmity, there is the assistance of man's rational fellow-creatures, to alleviate his pains, and minister to his necessities, and to supply the place of his own activity.

But a brute in his wild and natural state, does every thing for himself.

When his strength, therefore, or his speed, or his limbs, or his senses fail him, he is delivered over either to absolute famine, or to the lengthened wretchedness of a life slowly wasted by the scarcity of food.

If the present system, therefore, of pursuit and prey were altered, we should see the world filled with superannuated, half-starved, helpless, and unhelped animals.

And we should here remark, the limits under which this system of pursuit and prey is permitted.

The hare flies from the dog, but it feels no alarm at the hawk. The heron looks for the frogs in the ponds, but it never attacks the mole, or the field-mouse.

Each animal, therefore, has its peculiar objects from which to fly, or which to pursue. And Providence has given to each the necessary means of offence and defence.

This system of pursuit and prey, it may just be mentioned, is to the animals themselves the spring of motion and activity on both sides, both to the pursuer and the pursued.

The pursuit of prey forms the employment, and appears to constitute the pleasure of a considerable part of the animal creation.

The using of the means of defence, or flight, or precaution, forms also the business of another part.

And even in this latter tribe, we have no reason to suppose that their happiness is much molested by their fears.

Their danger exists continually, and in some cases they seem to be so far sensible of it, as to provide in the best manner they can against it; but it is only when the attack is actually made upon them, that they appear to suffer pain or uneasiness from it.

To contemplate the insecurity of their condition with anxiety and dread, would require a degree of reflection, which (happily for themselves) they do not possess.

Thus a hare, notwithstanding the number of its dangers and its enemies, is as playful an animal as any other, and probably as happy a one.

But to do justice to the question, the system of animals preying upon each other ought always to be considered along with another property of the nature of animals;

namely, their wonderful tendency to increase in numbers.

In almost all cases, nature produces her supplies with profusion; a single cod-fish spawns in one season a greater number of eggs than all the inhabitants of England amount to. And the quantity of frog-spawn, in almost every pond, is such, that if it were not devoured by birds, the surface of the country would be occupied by frogs n a very few years.

A thousand other instances of the increase of animals might be stated, which would carry on the multiplications of the species with a rapidity which outruns calculation, and to an immeasurable extent.

Where this vast fruitfulness meets with a proper vacancy in nature fitted to receive the species, there it operates with its whole effect, there it pours in its numbers, and replenishes the waste.

We complain of what we call the multiplication of some troublesome insects, not reflecting that large portions of nature might be left void without it.

Immense tracts of forests in North America, would be nearly lost to sensitive existence, if it were not for flies.

In the thinly inhabited regions of that Continent, in which the waters stagnate, and the climate is warm, the whole air is filled with crowds of these insects, and the waters and the marshes, with countless multitudes of frogs.

Hence, it is, that where we might have looked for solitude and death-like silence, we meet with animation, activity, and enjoyment, in a busy, a happy, and a peopled world!

The deserts of Africa, also, are found covered with locusts.

Do we so envy these abodes, as to pronounce the fecundity by which they are thus supplied with inhabitants, to be an evil, a subject of complaint, and not of praise.

It is by the means of this same fecundity, that what we term destruction becomes almost instantly the parent of new life.

What we call blights in corn, are oftentimes legions of animated beings, too small for us to see without a microscope, claiming their portion in the bounty of nature.

What corrupts the produce of the earth to us, prepares it for them; and it is by

means of their rapid multiplication, that they take possession of their pasture: a slow propagation of them would not meet the opportunity.

But then this fecundity, though of great occasional use and importance, may sometimes exceed the ordinary capacity of nature to receive or support its progeny.

All superabundance, therefore, must be followed by destruction, or it must destroy itself.

Perhaps there is no species of animals whatever which would not over-run the earth, if it were permitted to them to multiply in perfect safety; or any kind of fish which would not fill the ocean, if left to their natural increase, without disturbance or restraint.

The food of other species would be exhausted in supplying maintenance for this favoured species.

It is necessary, therefore, that the effects of such prolific qualities should be curtailed.

The thinnings which take place among animals, by their action upon one another, are the chief checks and limits.

In some instances we ourselves expe-

ri ence very directly, the use of these hostilities. One species of insects rids us of another species, or reduces their ranks.

The crow destroys the worm—the crane destroys the frog.

What further shows, that the system of destruction and of fruitfulness are parts of the same scheme of Providence, is, that in each species, the fruitfulness bears a proportion to the smallness of the animal, and to its weakness, and to the shortness of its natural life, and to the dangers and enemies by which it is surrounded.

An elephant produces but a single young one, and a butterfly lays six hundred eggs.

Birds of prey seldom produce more than two eggs; but the sparrow and the duck tribe, frequently sit upon a dozen.

In the rivers, we met with a thousand minnows for one pike; in the sea, we find a million of herrings for a single shark.

This is an order of things which can be accounted for in no other way, than by the benevolence of the Creator.

Why add pleasure to the act of eating, or sweetness, or relish to food? Why give a new sense for the perception of the pleasure?

Why should the juice of a peach, applied to the palate, affect the part so differently from what it does, when rubbed upon the palm of the hand?

Eating is necessary, but the pleasure attending it is not necessary; and this pleasure depends not only upon our being in possession of the sense of taste, which is different from every other, but upon a particular state of the organ in which it resides.

We must, many of us, have experienced that corruption of taste, which frequently occurs in fevers, when every taste is irregular, and every one is bad.

In mentioning the gratification of the palate, it may be said, that we have made choice of a trifling example.

But let us remember, that whilst their gratifications afford a share of enjoyment, even to man, they are to brutes of very great importance.

A horse at liberty passes a great part of his waking hours in eating.

The pleasure is doubled to the ox, the sheep, the deer, and other ruminating animals.

Their whole time almost is divided between browsing upon their pasture, and chewing their cud.

Whatever the pleasure be, it is spread over a large portion of their existence.

If there be animals such as the pike and shark, who swallow their prey whole, and at once, without any time for either drawing out or relishing the taste in the mouth, it is not, perhaps, an improbable conjecture, that the seat of taste with them is in the stomach.

If this opinion be right, they are more than repaid for the defect of palate. The feast lasts as long as the digestion.

The necessary purposes of hearing might have been answered without harmony; those of smell, without fragrance, and those of vision, without beauty.

It may reasonably be asked, why is any thing a pleasure? And there seems no answer, which can be returned to the question, but that which refers it to the benevolent appointment of our Maker.

The annexing of pain to the means which would destroy or injure us, is, also, a salutary provision, inasmuch, as it teaches vigilance and caution.

It both gives notice of danger and excites those endeavours, which may be necessary to preservation.

The evil consequence which sometimes arises from the want of that timely warning of danger, which pain gives, is known to the inhabitants of cold countries, by the example of frost bitten limbs, an injury not uncommon in the north of Europe, though seldom experienced in the happier climates of Great Britain and Ireland.

Persons who have lost toes and fingers by this cause, in general declare, that they were totally unconcious of any local uneasiness in the part affected at the time.

Some have even said, that whilst they were about their employment, neither their situation, nor the state of the air, was unpleasant.

They felt no pain, they suspected no mischief, till by the application of warmth, they discovered too late, the fatal injury, which some of their extremities had suffered.

This shows the use of pain, and that we stand in need of such a warner of danger.

Pain itself is not without its alleviations. It may be violent and frequent; but it is seldom both violent and long continued, and its pauses and intermissions become possitive pleasures.

It has the power of shedding a satisfaction over intervals of ease, which few enjoyments exceed.

A man resting from a fit of the stone, or gout, is for the time in possession of feelings of happiness which undisturbed health cannot impart.

Two very common observations favour this opinion; one is, that remissions of pain call forth from those who experience them stronger expressions of satisfaction and gratitude towards the Author of their relief, than are excited by advantages of any other kind.

The second is, that the spirits of sick men do not sink in proportion to the acuteness of their sufferings; but rather appear to be roused and supported, not by pain, but by the high degree of comfort, which they derive from its cessation, or even its subsiding, whenever that occurs.

But disease often assists, in a great degree, to abate the fear of death, which it does in a wonderful manner, and oftentimes by a mild and imperceptible gradation.

Brutes are in a great measure delivered from all anxiety on this account, by the inferiority of their faculties.

Or rather, they seem to be armed with the apprehension of death, just sufficiently to put them upon the means of preservation, and no farther.

But would a human being wish to purchase this freedom, by the loss of those powers of mind, which enable him to look forward to the future?

In thus speaking of death, we are alluding to it, only as the last struggle, which takes place before the soul and body separate.

Religion assures us, that there is a reward for the righteous; and this will, to a good man, calm the apprehensions, which every one must feel at the awful moment.

Eternal punishment, also, as surely awaits the wicked; and its near approach must, to such, infinitely augment the dread of death.

There is one circumstance connected with the close of life, which must affect, even the strongest, and most devout.

Death implies separation; and the loss of those whom we love, must necessarily, so far as we can conceive, be accompanied by pain to us.

To the brute creation, nature seems to have stepped in with some secret provision for their relief, under the breaking off of their attachments.

In their instincts towards their offspring, and of their offspring to them, it is surprising to observe, how ardently they love, and how soon they forget.

Rational occupation coupled with, and directed by religion, is, amongst men, the very source of contented existence.

But there would be no place left for occupation, if either the things with which we had to do, were absolutely impracticable to our endeavours, or if they were too obedient to our uses.

A world furnished with advantages on one side, and beset with difficulties, wants, and inconveniences, on the other, is the proper abode of free, rational, and active natures.

Because it is the fittest to sharpen their faculties.

A world, in which nothing depended on ourselves, however it might have suited an imaginary race of human beings, would not have suited mankind.

Our skill, prudence, and industry—our various arts, and our best attainments, from the application of which we draw our most permanent gratifications, would be insignificant, if things could be either moulded by our mere will, or of their own accord, conform themselves to our views and wishes.

The distinctions of ranks in civil life are apt enough to be regarded as evils, but perhaps it will be found, with very little reason.

In the first place, the advantages which the higher conditions of life are supposed to confer, bear no proportion in value to the advantages which are bestowed by nature.

The gifts of nature always surpass the gifts of fortune.

How much, for example, is activity better than attendance, beauty than dress, appetite, digestion, and health, than all

the studies of cookery, or than the most costly collection of forced, or far-fetched dainties.

By the simplicity of humble life, a man is released from the cares, which perplex those who have great affairs to manage.

His plain meal satisfies his appetite, and he eats it with a greater relish than many a rich man enjoys, who sits down to a splendid banquet. His sleep is sounder, health firmer, and he knows not what languor and listlessness are.

Nature has a strong tendency to equalization. Habit, the instrument of nature, is a great leveller.

The familiarity which habit induces, takes off the edge, both of our pleasures, and our sufferings.

Indulgences, which are habitual, only keep us in ease, but cannot be carried much farther.

It seems also, to be necessary for our happiness, as well as for our good, that the period of human life should be uncertain.

For, if mortality followed any fixed rule, it would produce a security in those that were at a distance from it, which would lead to the greatest disorder.

And it would produce an indescribable apprehension in those who approached it, often similar to that which a condemned prisoner feels on the night before his execution.

But in order that death should be uncertain, the young must sometimes die as well as the old.

And, if deaths were never sudden, they who are in health would be too confident of life.

In that case, the strong and the active, who most want to be warned and checked, would be too apt to live without apprehension or restraint.

On the other hand, were sudden death very frequent, the sense of common jeopardy would interfere too much with the degree of ease and enjoyment intended for us.

And human life would be too uncertain for the business and interests which belong to it.

In this case, there could not be dependance either upon our own lives, or the lives of those with whom we are connected, sufficient to carry on the regular offices of human society.

The manner, therefore, in which death is made to occur, conduces to the purposes of warning, without overthrowing the necessary stability of human affairs.

The seasons are a mixture of regularity and chance.

They are regular enough to authorize expectation, whilst their being in a considerable degree irregular, induces a necessity for our personal attendance, for activity, vigilance, and precaution.

It is found, in fact, that where the soil is the most fruitful, and the seasons the most constant, there the condition of the cultivators of the earth is the most depressed.

Uncertainty, therefore, has its use, even to those who sometimes complain of it the most.

Seasons of scarcity themselves are not without their advantages.

They call forth new exertions, they set contrivance and ingenuity to work: they give birth to improvements in agriculture and economy, and they promote the investigation and management of public resources. And, above all, they give opportunities for the display of the kinder feelings

of our nature, in the assistance which they call forth from man to his fellow.

Human life is not a state of unmixed happiness, nor is it a state of designed misery; it is not a state of retribution, it is not a state of punishment. It suits with none of these suppositions.

It accords much better with the idea of its being a state of probation; that is, a condition calculated for the production, exercise, and improvement of moral qualities, with a view to their fitting us to bear our part in a future state.

There is no situation in which a rational being is placed, from that of the best instructed Christian down to the condition of the rudest Barbarian, but affords room for the exercise of qualities, good or bad.

Health and sickness, enjoyment and suffering, riches and poverty, knowledge and ignorance, power and subjection, liberty and bondage, civilization and barbarity, have all their offices and duties, all serve for the formation of character.

The best dispositions may subsist under the most depressed and most afflicted fortunes. A West Indian slave, for example, amidst all his wrongs, may retain his benevolence.

The kind master of such a slave, who, in the exercise of a boundless authority, postpones his own interest to his slave's comfort, is a meritorious character.

But still he is inferior in goodness to such a slave. These conditions, opposite as they may be in every other view, are both trials; each is a state of probation. The master and the slave is each upon his trial, how he will act his part in the state of life to which he is called.

Again, one man's sufferings may be another man's trial. The family of a sick parent is a school of filial piety.

And the charities of domestic life, and not only these, but all the social virtues, are called forth by the distresses of our neighbour.

But then misery, to be the proper object of benevolence, must be really or apparently casual.

For were there no evils in the world, but what were visible punishments, benevolence would only stand in the way of justice.

Such evils, consistently with the administration of moral government, could not be prevented.

The degree of happiness which we usually enjoy in this life, is better suited to a

state of trial and probation, than a greater degree would be.

The truth is, we are rather too much delighted with the world, than too little.

Imperfect, broken, and uncertain, as our pleasures are, they are more than sufficient to attach us to the eager pursuit of them.

A due regard to a Future State can hardly keep its proper place as it is. If we were designed, therefore, to be influenced by that regard, might not a more indulgent system have interfered with the design?

We see the same intelligent power fixing the ring of the planet Saturn, two hundred thousand miles in diameter, to surround its body; and suspending it like a magnificent arch, over the heads of its inhabitants.

And we see the same Power bending a hooked tooth for the bat's wing; or providing a proper mechanism for the clasping and unclasping the filaments of the feather of the humming bird.

We have proof not only of both these works proceeding from an intelligent Author, but of their proceeding from the same Author.

For we can trace a sameness of plan from the planet Saturn to our own globe.

Therefore, one Mind hath planned all these productions, one being has been concerned in them all.

Under this stupendous Being we live; our happiness, our existence is in his hands. All we expect must come from Him.

Nor ought we to feel our situation insecure. In every nature, and in every portion of nature which we view, we find His attention bestowed upon even the minutest objects.

The hinges in the wings of an earwig, and the joints of its feelers, are as highly wrought, as if the Creator had nothing else to finish.

We see no signs or diminution of care by the multiplication of objects, nor of distraction of His thought by their variety.

We have no reason to fear, therefore, our being forgotten, or overlooked, or neglected.

The existence and character of the Deity is, in every view, the most interesting of all human speculations.

In none, however, is it more so, than as it leads to the belief of the fundamental articles of Revelation.

It is a step to have it proved, that there

must be something in the world, more than what we see.

And it is a further step to know, that among the invisible things of nature, there must be an intelligent Creator, concerned in its production, order and support.

But upon no other article of Revealed Religion does the belief of a Deity bear with so much force, as upon that grand point, the resurrection of the Human Dead.

The thing might appear hopeless, did we not see a Power at work able and adequate to the office. A Power under the guidance of spiritual will, and a Power penetrating the inmost recesses of all substances.

Are there any who think that the weakness of the human faculties, in our present state, seems ill to accord with the high destinies, which the expectations of Revealed Religion teach us to entertain.

Let such persons only consider, whether any one who saw a child two hours after its birth, could suppose that it would ever come to understand mathematics.

Upon the whole, in every thing which respects our future awful, but as we trust, our glorious change, we have a wise and powerful Being upon whom to rely, for the choice and appointment of means adequate

to the execution of any plan, which his goodness may have formed.

That great office rests with Him.

Be it our part to hope, and with his assistance to prepare ourselves: under a firm and settled persuasion, that whether living or dying we are His, that life is passed in his constant presence, and that death resigns us to His merciful disposal.

CHAP. V.

The surface of the earth which we inhabit is not, as it appears, one great plain, broken only by hills and valleys.

The real shape of the earth is that of a round ball, somewhat flattened at each end, like an orange.

The largest mountain in the world is not greater in comparison to the whole earth, than a grain of dust is to an apple.

And all Ireland is not larger, when compared to the whole surface of the earth, than the smallest speck which could be made on the apple with the tip of one's little finger, compared with the entire surface.

The whole ball of the earth is very large; a line drawn through the heart of it from

one side to the other, would be no less than 8,000 miles in length.

A line drawn all round the Earth would be above 24,000 miles long.

The roundness of the Earth is the reason why we cannot see above a few miles from us at sea, or upon a great plain; for the surface of the Earth dips down from us, and we lose sight of it.

The circle that bounds or ends our view on all sides, where the sky appears to meet the Earth, is called the horizon.

When God Almighty made the Earth, He appointed it to move round the Sun once in every year.

And the Earth has been moving round the Sun, ever since the creation of the world to the present time.

The circle in which the Earth moves as it goes round the Sun, is called the Earth's orbit, or the Earth's path.

We do not perceive the motion of the Earth for many reasons, partly because we are used to it from childhood; but principally, because every thing on the Earth, and even the air, and the clouds above it, are all carried round together, and we do not see any thing change its place in consequence, and so are not sensible of the motion.

The Sun is a great ball vastly larger than the Earth.

It is no less than a million of times larger than the Earth; that is, a thousand times a thousand times larger; so that if there were a ball a thousand times larger than the Earth, the Sun would still be a thousand times larger than that ball.

Astronomers have discovered by good telescopes, that there are dark spots in the Sun, which are supposed to be holes in the surface, and which are larger than the entire of the Earth.

We do not know of what substance the Sun is made; but as it gives so much light and heat, we may suppose that it is more like to fire, than to any other thing that we are acquainted with.

The reason why this prodigious body which we call the Sun appears so small, is the immense distance at which it is placed from us.

The Sun is really about ninety-five millions of miles from us; but we are so little accustomed to think of such great distances that it is difficult at once to comprehend how great a distance that really is.

It may give some general idea of it to say, that if a cannon-ball, which moves so fast as to be invisible, were to fly from

hence towards the Sun, at the same rate at which it moves when fired from a cannon, and were never to stop, it would require above twenty two years before it would reach him.

And yet the Earth would reach the Sun in two months, if it were to rush towards the Sun with the same swiftness that it moves at present round him.

Hence, we see, how very much faster than a cannon-ball the Earth's motion is, as it moves in its path round the Sun.

For the Earth moves, in two months, through a space that it would require twenty-two years for a cannon-ball to fly through.

And a cannon-ball would actually require a hundred and thirty-two years to fly round the Sun, in the same circle that the Earth moves through in one year.

Some of us have seen a balloon moving through the air, and have been struck with the grandeur of the sight.

And, perhaps, we may have reflected on the astonishing speed of a cannon-ball.

But what is the size of a balloon, compared to that of this entire earth? And what is the speed of a cannon-ball, compared to the swiftness of the Earth, in its journey round the Sun?

It is indeed an idea which our imagination can hardly compass, that this great Globe which we inhabit, this solid Earth, with all its cities, its mountains, and its oceans, has, during so many thousands of years, been flying with such enormous force round and round through the same circle, neither slower nor faster, neither higher nor lower; but along the same invisible path, originally directed by our Almighty Creator.

There is no room, however, for any doubt about the fact of the Earth's moving at this rate.

Learned men have carried mathematical knowledge to such perfection, that they can measure the speed of the Earth in its journey round the Sun, as accurately as the motion of a carriage upon a road.

The use of this long and rapid journey of the Earth round the Sun, is to produce the change of the seasons, Spring, Summer, Autumn, and Winter.

For it is owing to this motion, that Spring and Summer, Autumn and Winter, succeed to each other.

This is effected in the following manner:—

While the Earth is going round the Sun,

it sometimes points its north part rather more towards the Sun than its south part.

And it is then Summer in the countries which lie towards the north part of the Earth.

And at the same time it is Winter in the countries which lie towards the south, which are then turned more away from the Sun.

Six months afterwards, the south part is, in its turn, pointed more towards the sun than the north part is, and then it is Winter towards the north part, and Summer towards the south part of the Earth.

In Spring and Autumn, the north and south parts of Europe are, neither of them, pointed towards the Sun, one more than the other, but are at the same distance from him.

While the earth moves round the Sun in the manner we have described, once in every year, it has another motion equally wonderful, round a line within its own body.

In order to understand this, let us suppose a ball with a sharp wire drawn through its centre; suppose then you hold this wire fast by one hand, and with the other, turn the ball round and round upon the wire. This is the nature of what is called the motion of the Earth round its axis. For what

is the wire in the ball, is called the axis when we speak of the Earth.

Exactly such a line may be supposed to pass through and through this Earth; it is called the Earth's axis, and every part of the Earth moves round this line in the same manner that the ball moves round the wire.

The Earth moves round its axis once in every twenty-four hours, and it is this motion which produces the changes of day and night on our Earth.

The two places where the axis meets the surface of the Earth are called the Poles, and are termed the North Pole and the South Pole.

It may be observed that these Poles are the only points on the Earth's surface that do not move round the axis, for they are in the axis, being in fact the two ends of it.

When the motion of the Earth brings that side on which Ireland is towards the Sun, it is Day in Ireland; and when the Earth turns half round, and Ireland is on the side turned away from the Sun, it is Night in Ireland.

It is always day through half of the world, and always night through the other half.

When it is day in Ireland, it is night on the other side of the Earth; that is, it is night at Botany Bay, in New Holland.

When we get the first glimpse of the Sun in the morning, we call it Sun-rise.

As the Earth goes on turning, the Sun seems to mount over our heads.

When the Sun appears at the highest, we call it Mid-day.

After that, by the motion of the Earth, we are turned more and more away from the Sun until night, when we lose sight of the Sun altogether.

During the night, we are carried half way round the axis of the Earth, which brings us once more in sight of the Sun on the following morning.

Hence we see, that although the Sun appears, to our eyes, to go round the Earth once in every day and night, our eyes by this appearance are deceived; for it is the Earth all the while which is turning on its axis, and the Sun really stands quite still.

The shape of the Moon, like the Sun and the Earth, is a ball. The Earth is about sixty times as large as the Moon, and the Sun is no less than sixty millions of times larger than the Moon.

The reason that the Sun and Moon appear to our eyes nearly of the same size, is,

that the small body of the Moon is much nearer to us than the Sun is, and the large body of the Sun is very far from us.

The Moon is about 240,000 miles from the Earth.

A cannon-ball would be about twenty-one days flying from the Earth to the Moon, but it would take no less than twenty-two years to go from the Earth to the Sun.

The Moon has no light of her own, but appears bright only when shone upon by the Sun.

We have all observed how the glass of a window appears when the Sun shines on it. But the glass has no light of its own, and we cannot see it unless there is light from some other thing which strikes upon it, by which we may see it.

The case is the same with the Moon. The Sun is always shining upon one half of the Moon, and the other half is in total darkness.

When the Moon shows to us that part of her body which is lighted by the Sun, we call it Full-moon.

When she shows to us only half of the part that is lighted, we call it Half-moon.

And when the whole of the illuminated part has been turned away from us, and she

is just beginning to show us a part of the illuminated side again, we call it New-moon.

It does not at first appear evident, why our seeing only a small part of the illuminated side of the Moon, should produce that horned appearance which we call a crescent.

But we shall easily understand the reason, if we take any white ball, and colour half of it black, and walk round it at some distance from it; we shall then see its white side show all the shapes that the Moon exhibits.

The Earth is of the same use to the Moon that the Moon is to the Earth, and appears to her nearly as the Moon does to us, but a great deal larger.

The Earth appears to the Moon nearly sixty times as large as the Moon does to the Earth.

The Moon moves in a circle round the Earth, in the same manner that the Earth moves round the Sun.

The Moon moves round the Earth once in a month.

The Moon also moves round her own axis, but much slower than the Earth does round her's.

The Moon moves round her axis once in twenty-eight days, so that there are only thirteen days and nights in the Moon's

year, but every one of her days are of the same length as twenty-eight of ours.

We have not yet done speaking of the Moon; we must say a few words of Eclipses.

When the Moon gets between the Earth and the Sun, a part of the Sun appears to us to be covered by the body of the Moon.

This is what is called an Eclipse of the Sun.

When the Moon gets behind the Earth, that is, when the Earth is directly between the Sun and the Moon, the Moon sometimes falls into the Earth's shadow.

For there is always a great shadow thrown out behind the Earth at the side farthest from the Sun, which shadow we call Night, and this reaches as far as the Moon, and farther too.

When the Moon falls into this shadow, it loses all light from the Sun, and we call it an Eclipse of the Moon.

In former times, many people were so ignorant as to be frightened at these Eclipses, but the above are the simple causes of them, and so well are they now understood, that astronomers can tell to a day, and even to a minute, at what time these Eclipses are to happen, for thousands of years to come.

What a proof of the wonderful exactness of mathematical knowledge, and how much education can raise one man above another.

The principal use of the Moon to us, as every one knows, is to give light in the night.

Its connexion with our affairs does not, however, stop here.

It is the cause of the Tides in the sea—we have spring tides at full-moon and also at new-moon, so that we have spring tides once in every fortnight. The neap tides are at the periods of half-moon.

The Moon is also thought to have a considerable effect upon our weather, probably by occasioning tides in the air over our heads, like the tides in the water; for the air is a fluid like water, only much thinner, and must be acted on by the Moon in the same manner, but in a still greater degree.

In former times, many nations paid Divine Worship both to the Sun and Moon.

You read in the Scriptures how the Assyrians and Canaanites adored Baal as a God, and Ashtaroth as a Goddess,—now Baal was the Sun, and Ashtaroth was the Moon.

We read in the book of Job this reflection of his under his sufferings—"If I be-

held the Sun when it shined, or the Moon walking in brightness, and my heart hath been secretly enticed, or my mouth had kissed my hand, this also were an iniquity to be punished by the Judge, for I should have denied the God that is above."

By the enticing of his heart, Job meant the sin of worshipping those Bodies.

And by the kissing of his hand, he meant the swearing by them as Gods.

Job lived in those times and amongst those nations; but we are more happy than they, in having had revealed to us the one true God Almighty, who made both the Sun, and the Moon, and this Earth, and our immortal souls, and who sent us into this world to see His wondrous works, and to praise His goodness, and to obey His commandments, and thus, with His aid, to fit ourselves for eternity.

And it is the same True and Great God whom we take to witness the truth of our oaths when we swear; and whose wrath and vengeance we call down upon our heads if we swear falsely.

A witness in a Court of Justice should well consider this.

And he that takes an oath out of a Court of Justice, to engage himself in any under-

taking, calls upon the pure and Holy God to become a party in what he is about.

And if his purpose is a purpose of crime, he in fact is guilty of the horrid blasphemy of inviting the Almighty to become his accomplice—he calls on the Divine Purity to witness his guilty intention—he calls on the Divine Justice to mark the steps by which he shall pursue it.

What a daring insult to the purity of God! What a dreadful defiance of his Justice and of his Wrath!

And He that made the Ear shall he not hear?

And He that made the Eye shall he not see?

Such a blasphemous oath must be repented of, but not performed.

Such an oath does not bind.—The wretched man who acts in obedience to such an oath, only adds one sin to another.

Most people think this world, or Earth, in which we live, of vast consequence, but if there were any inhabitants in the Sun, they would probably be of a very different opinion.

This earth would appear to them but a very small speck, not larger than one of those bright stars which we see in a frosty night; and then as for this little moon of

ours, which attends upon the Earth, it is so very small, that from the Sun it could not be distinguished at all, or at least not without the help of a very good telescope.

But the spectator in the Sun, would not want telescopes to see other and finer worlds than ours rolling round him, one of which is indeed no less than thirteen hundred times larger than this Earth.

These other worlds are all shaped like our earth, that is, they are great balls, (by learned men called spheres.)

And they move in the same manner as the Earth does, in great circles round the Sun.

These bodies are generally called the Planets.

Each Planet moves in a circle of its own round the Sun, which is called its path or its orbit.

These paths or orbits are not all of the same size; a Planet near the Sun necessarily moves in an orbit smaller than the orbit of a Planet more distant from the Sun.

The nearest to the Sun is Mercury.

Then comes Venus.

Then the Earth.

Then Mars.

Then Jupiter.

Then Saturn.

Then Herschel, called also the Georgium Sidus.

These Planets appear to our eyes very like the stars, so much so, that few people perceive the difference.

The Planets have no light of their own, but appear bright to us only from the same cause as the Moon, namely that they are shone upon by the Sun. They may be distinguished by their shining with a steady light, and not twinkling like the Stars.

These Planets resemble the Earth in many points.

Each moves round its own axis, and therefore, like the Earth, each has its days and nights.

They also like the Earth have their various Seasons, their winters, their summers, their seed times, and their harvests.

On one of them we can distinguish, with the help of the best telescopes, a whiteness about the poles in her winters, which disappears in her summers.

It is probable that this may be her snow.

The Moon, which is so much nearer to us than any of the Planets, we can distinguish more easily than them; and with a good telescope we can distinctly see great mountains, rugged precipices, broad valleys, and deep pits on her surface.

There are also large dark looking plains in the Moon, which are, perhaps her Seas.

It is indeed not quite certain that there is any Water in the Moon, but it seems pretty clear that there is Fire, for flashes have been seen distinctly with glasses when the Moon was in eclipse.

It is not, however, known, whether these flashes were the explosion of burning mountains, or lightning in the Moon.

We will now speak a few words of the different Planets, and first of Mercury.

Mercury moves round the Sun in eighty-seven days, that is in rather less than three of our months.

The distance of Mercury from the Sun is about thirty-five millions of miles, that is a little more than one third of the distance of our Earth from the Sun.

This Mercury is but a small world, about a quarter of a quarter as large as our Earth.

Small as he is, he is however four times larger than our Moon, but he is so far off that he appears very small.

It must be very hot in Mercury, at least nine times as hot as in the Earth. The brilliancy of the Sun's light must also be in the same proportion.

An inhabitant of this Earth could hardly live in Mercury, he would be blinded with

the brightness of the day, and parched up with the hotness of the air.

The Planet next in order moving round the Sun is Venus.

Venus is much about the size of our own Earth, her year is not so long as ours.

The distance of Venus from the Sun is about seventy millions of miles, that is about three fourths of the distance of our Earth.

The quantities of light and heat in Venus, are not very different from what we have here, they are both rather greater than with us.

We often see Venus: she is that bright star which we sometimes call the morning and sometimes the evening star. Think of this when next you see the morning or the evening star.

The next Planet in succession, is our own Earth, of which we have already spoken.

The next beyond our Earth, is the Planet called Mars.

Mars is about one eighth part the size of our Earth, his distance from the Sun is once and a half as great as ours, his light and heat are of course considerably less.

We very often see Mars among the heavenly bodies, you may know him by his shining with a dusky but steady red light.

The next Planet is Jupiter.

Jupiter is an immense Planet, about one thousand three hundred times larger than our Earth. His distance from the Sun is about four times greater than ours.

His year is as long as twelve of ours, for he takes all that time to go round the sun, and yet he moves seventy times faster than a cannon ball, but the size of the circle in which he moves is so very great, that it requires all that time for him to go round the Sun.

The heat and light in Jupiter are weak, owing to his distance from the Sun. It is probable that the summer in Jupiter, is colder than the winter of our Earth.

Jupiter moves round his axis once every ten hours, so that his days and nights are very short.

The nights of Jupiter are brilliantly illuminated, for God Almighty who created this Earth, and Jupiter, and all the Host of Heaven, has provided that distant Planet with no less than four Moons.

These Moons which are of so great importance to Jupiter, are quite invisible to us, except with telescopes, owing to their distance from us.

One of Jupiter's Moons is as large as our whole earth.

Our Moon is quite invisible to Jupiter, it must be an excellent telescope indeed, by which it could be distinguished at all by an observer in that Planet.

We see Jupiter very often; he appears to our eyes one of the largest, brightest, and most beautiful of all the bodies which shine in the firmament above us.

The next beyond Jupiter, is Saturn, another mighty Planet, one thousand times larger than our Earth, and ten times more remote from the Sun.

Saturn is above twenty-nine years in performing his journey round the Sun.

Saturn is provided with seven Moons to cheer his nights.

But the care of Providence has not stopped there. He is further provided with a contrivance which well deserves admiration.

For around his body he is belted with a mighty ring, apparently made of the same substance as the Planet.

This ring does not touch the body of Saturn, but is hung round him at the distance of about fifty thousand miles on all sides from the body of the Planet.

This ring is so great that there would be room for our whole Earth to roll upon it, as a boy's marble might upon a carriage wheel.

This ring shines upon the Planet when it is shone upon by the Sun, as the Moon does upon our Earth.

Sometimes one side of the Ring shines, sometimes the other, sometimes one side and the inside edge or thickness shine together.

All this must have the most brilliant and extraordinary appearance as seen from that Planet.

The rising of Saturn is quite invisible to our unassisted eyes, but can be very clearly seen with good telescopes.

There is another and still more distant Planet, of which we know but little. It was lately discovered by an astronomer in England, named Herschel, and called by him the Georgium Sidus, in honor of our late revered king, George the III.

This Planet is nineteen times more remote from the Sun than our Earth, he is ninety times as large as our Earth, and is about eighty-five of our years in performing his journey round the Sun; he is attended by at least six moons.

It will be right now to say something of Comets, but our knowledge of them is very confined.

They seem to be bodies so far like the Planets that they move round the Sun, not,

however, in circular paths like them, but in that sort of figure which is called an oval or ellipse; these orbits of the comets are usually very long in proportion to their breaths, and the Sun is always within the oval, and very close to the end of it, so that when the Comet is in that part of its path it is very close to the Sun.

When the Comets thus approach to the Sun, they seem to take fire, and to throw out a long tail of light, some millions of miles in length.

When the Comet comes down among our Planets, we see it, and when it goes off to the remote parts of its orbit, we lose sight of it.

Learned men have computed that these Comets when set on fire by the Sun are some hundreds of times hotter than red hot iron, and that when in the remote parts of their orbits, they are vastly colder than ice.

Some people have been greatly frightened at the approach of a Comet. It certainly is not quite impossible that one of them might strike against the Earth, and if this were to happen we should all probably be destroyed.

But this is very unlikely; for of all the hundreds of Comets that have appeared, none have ever touched any of the Planets.

The bodies that have already been mentioned, namely the Sun, the Planets, with their Moons, and the Comets, form what is called the Solar System, which means a particular company of the heavenly bodies dependant upon our Sun.

But in every clear night we see multitudes of other Stars in the vault of heaven, about which we must now say something.

They are called the fixed Stars.

These are bodies which do not shine with a weak or borrowed light like the Planets, but with a light of their own, bright as that of our own Sun itself, as we should be convinced if we were equally near to them.

None of the learned astronomers have any doubt that they are indeed real Suns quite independent of this Sun of ours.

Each of them, like him, is not improbably the centre of a Solar System of its own, with Planets, Moons, and Comets, rolling round it.

The distance of these Stars from us is inconceivable by any human imagination.

The whole orbit of the Earth is but a mere point in comparison of it. A cannon ball would not reach the nearest of these in ten thousand centuries.

A century is one hundred years.

If a cannon ball had begun to fly towards the nearest Star at the time of the Creation, that is about sixty centuries ago, all the space through which it would have travelled up to this time, could scarcely be considered as more than a single step of the journey.

The Stars appear to us to rise in the East every evening, and to move over our heads to the Westward, as the night advances.

But all this is a deception of our sight; it is the Earth that is moving round its own axis; the Stars themselves stand perfectly still, and hence it is they are called the fixed Stars.

The number of these fixed Stars, seen through good telescopes, seems almost as great as that of the sand of the sea.

In one little cluster of them which is called the Pleiades, where the naked eye has reckoned but seven Stars, Herschel's telescope has shown two thousand.

The total number which our eye can distinguish in the clearest night, great as it appears, does not really exceed one thousand, but the number discernible by this great glass is calculated at eighty millions, that is, eighty thousand by the glass, for every single star which we can see by the naked eye.

And who will presume to suppose, that God has created no more stars than just what an English glass-maker has been able as yet to discover?

If the maker of that great telescope could make his glasses still more powerful, can it be doubted that we should discern still more distant stars?

We must take care not to confound any of these remote Suns with what are called falling Stars. These last are, as it were, mere sparks of fire, only a few miles above our Earth.

Neither are we to suppose that these Suns which are so distant from us, are very near each other, though they appear to be so; this is a mistake of our eye-sight.

In truth, there is no reason to suppose that any two of them are nearer to each other, than the nearest of them is to us.

The boundless extent of space allows room and room enough, even for such countless numbers of immeasureable distances as we are thus obliged to conceive.

It is even probable, that if we were removed to the most distant part of the stars which we see, we should still discover beyond us quite as many new stars as those which we should have left behind.

Do you now think, that those distant

and mighty Suns were created only to astonish the few persons who have looked through Herschel's telescope?

Is it not more reasonable to suppose that each resembles our Sun in the end for which it was created, that is, to give light and heat, day and night, summer and winter, seed time and harvest, to Planets and Moons rolling round them?

Why should we suppose them to have been created in vain, and to fill the regions of remote space to no purpose?

On this Earth of ours we see that every spot is swarming with living creatures,—even those parts where mankind cannot live, are filled with animal life.

The deserts of Africa abound with millions of serpents, and with clouds of locusts, that take away the light of heaven from the country over which they fly.

There are great tracts of land in Siberia covered with mice.

The swamps of America are so peopled with gnats and midges, that the very air seems to be made of them.

Even the water is as thickly inhabited as the land.

A few cod fish would in the space of a single year, produce an offspring more numerous than the whole human race.

It seems, therefore, too much to suppose that while every corner of this little planet of ours is thus swarming with life, all these distant, glorious, great, and innumerable worlds, of which we have spoken, are vacant deserts, created merely to amuse Doctor Herschel in a clear night.

In the planets of our Solar System which fall within our power of observation, we have ascertained the changes of day and night, and a regular succession of the seasons, and for most of them, the existence of their respective moons.

Are we hastily to presume that these days are intended for no labour, and that these nights administer to no repose; that these seasons produce no crops, or that these crops are provided for no consumers, or that the nights of these planets are cheered by moons which no eye is to behold?

Or are we to presume that Creation ceases exactly at those other Stars, which might become visible to an observer removed to the most distant Star to which our eye can now reach?

Where then does Creation end?

Perhaps no where.

Space still remains beyond any conceivable limit—space boundless and endless,

beyond the remotest point to which our thoughts can range. And why should we suppose that space to be unoccupied by God's works?

We acknowledge that God fills all space, this is what we mean when we say that he is infinite; and who shall venture to assert that in any place where he is present, his goodness ceases to exert itself?

If the difficulty is on the one hand great, of supposing Creation without an end, it will be found just as difficult to suppose, that there are any bounds to space.

Try only to imagine yourself at the boundary, and can you even fancy that there is no space still beyond you?

The Eternity of time presents the same, but no greater difficulties to our understandings, than the infinity of space.

And is a subject far more pressing on us to consider.

We acknowledge that God has had no beginning, and will have no end, but that He has been and will be for ever.

This is what we mean, when we say, that God is Eternal.

We know that our own life has had a beginning, but that it will have no end, for we know that we shall live for ever in

another world, either happy or miserable, according to our conduct in this life.

We are sent into this world to pass a very short time, which will determine our fate in Eternity, by the manner in which we pass it.

If our whole fortune in this life were to depend on our own conduct during a single hour, how careful should we be during that hour?

But the importance of Eternity compared with the longest life, immeasurably exceeds the importance of life as compared with an hour.

Imagine yourself, if you can, at the last hour of time, and what is there that can prevent another hour from still succeeding?

Can you imagine time to stand still and cease.

Living for ever means, then, that we shall live, and think, and feel, as long as one hour can succeed to another.

Now imagine a mountain of dust reaching to the clouds, and its bottom to cover the largest extent of country your eye ever saw.

And imagine one grain of this dust to be taken away every thousand years.

Every grain of dust would, at last, be taken away—no thought, indeed, can reach the length of time that would be required;

but the time would at last certainly come, and after it had come, a new hour would still succeed as easily and as certainly as the hour that had just passed.

And eternity would still remain—and remain undiminished!

In the same manner, after the utmost progress which our imagination can make, towards the bounds of space, space still remains beyond.

What right have we to suppose that space is there for nothing.

Well might the Royal Psalmist say, "When I consider the heavens, the work of thy fingers; the moon and the stars, which thou hast ordained, what is Man that thou art mindful of him, and the son of Man that thou visitest him?"

It is, indeed, enough to make our hearts sink when we think of our own comparative insignificance, and of the nothingness of this little speck of Earth, compared with the glorious scene which is thus spread out over our heads.

But the care of our Almighty Creator is directed to the smallest as well as the greatest of his works.

Every flower of the field is formed by His power, and upheld by His pro-

Every fly and reptile has its heart, and its brains, and its lungs, and its blood vessels, as carefully and as curiously constructed as those of Man himself.

God has time and power and attention for every thing; He never slumbers or sleeps; He is about our path and about our bed, and seeth all our ways.

He has expressly assured us by Jesus Christ himself, that He has numbered the very hairs of our heads, and that not even a sparrow falls to the ground without His seeing it.

Let us, therefore, while we adore the immensity of His power, put our whole trust in His fatherly protection and care for every one of us.

And let us think well of the consequences of ever disobeying His commandments.

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