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THE SENSES

AND

THE MIND.

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THE SENSES AND THE MIND.

CHAPTER I.

ON THE GENERAL RELATIONSHIP OF MAN TO THE WORLD AROUND HIM, AND HIS ADAPTATION TO THE PLANET HE TENANTS.

THERE are few, at least among the reflecting portion of society, who have not either mentally or verbally asked the question: Is the sun—is the moon—are the planets, with their satellites —are the stars, those suns of other systems, tenanted, as is our planet, the earth, by living beings, which declare the omnipotence of God? This is one of many questions which cannot be answered. The probability, to judge from analogy, is, that some, if not all, are inhabited; that some are in a course of preparation for beings which God will, in his own time, call into existence; and that in all, changes have taken place more or less similar to those which have occurred on the globe we tenant, and which have been connected with the extinction of races, and the creation of others adapted and organized for an altered condition of the earth's surface, and of the circumambient atmo-

sphere. But, granting these suppositions, it must be evident, that the living beings in the sun, the planets, and the asteroids, must not only be differently constructed from those which inhabit our planet, the earth ; but, also, that in different worlds, the living inhabitants must be very diversely constituted, not only as regards their senses, but also their organization and their powers of locomotion.

We cannot conceive of beings unlike ourselves, and the animals, terrestrial and aquatic, which, called into existence by Almighty Power, people the surface of our earth ; that, however, is no reason why such beings should not exist, for what is impossible with God ? Nay, as it is, the senses, the operations, the powers, and economy of insects confound us, and lead us to suspect that they possess a sense, or senses, which, because denied to us, we cannot appreciate. In our world, atmospheric air, in which oxygen prevails, or water, also oxygenated, is essential to the maintenance of animal life. But cannot the Almighty construct organic beings, independent of our air or our water—vitalized, in fact, on principles of which we can form no idea ? Undoubtedly. If, for example, no aquatic water-breathing animals, as fishes, crustacea, etc., existed on our earth, could we conceive of the possibility of their being ? or, were our race, and all other animals furnished with gills instead of lungs, and ordained to a sub-aquatic life, making the wide ocean our home, could we form any idea of

what creatures could be constituted for living in the thin atmosphere, and actively enjoying life under its pressure? Again, let the attractive force of this earth be altered, the organization of every living thing must (granting its existence to be guaranteed) be altered accordingly. We take the following from Miss Somerville's "Connexion of the Physical Sciences," p. 73:—"The densities of bodies are proportional to their masses, divided by their volumes. Hence, if the sun and planets be assumed to be spheres, their volumes will be as the cubes of their diameters. Now, the apparent diameters of the sun and earth, at their mean distance, are 1922″, 8, and 17″, 1552, and the mass of the earth is the 354,936th part of that of the sun, taken as the unit. It follows, therefore, that the earth is nearly four times as dense as the sun; but the sun is so large that his attractive force would cause bodies to fall through about 335 feet in 1″; consequently, if inhabited by human beings, they would be unable to move, since their weight would be thirty times as great as it is here." A man of moderate size would weigh about two tons at the surface of the sun; whereas, at the surface of the asteroids, (the clusters between Mars and Jupiter,) he would be so light that he could not stand steadily, since he would only weigh a few pounds.

The densities, that of water being 1, as far as can be satisfactorily explained, are as follow:—Sun, $1\frac{2}{10}$; Mercury, $9\frac{1}{6}$; Venus, $5\frac{11}{10}$;

Moon, $4\frac{1}{2}$; Mars, $3\frac{2}{7}$; Ceres, 2; Pallas, 2; Jupiter, $1\frac{1}{2\,4}$; Saturn, $\frac{1}{3}\frac{3}{2}$; Herschel, $\frac{2\,9}{1\,0\,0}$.

Similar observations apply to the influence of the atmosphere, in whatever point of view we consider it, that is, whether we regard its weight, its electrical condition, its illumination, its temperature, its dryness, or humidity.

1. *Its Weight.*—The weight of the atmosphere (an elastic, compressible, and expansible fluid,) is calculated to be from fourteen to fifteen pounds avoirdupois on every square inch, (pure water, taking bulk for bulk, being about 828 times as heavy.) Now, reckoning the surface of a middle-sized man to be fourteen feet, he sustains the pressure of eleven tons. Many of our readers have seen the philosophical experiment of placing two hollow metallic hemispheres rim to rim, the rims being nicely adjusted and smeared with lard; this being done, the air, by means of a stop-cock on the lower hemisphere, screwed into a powerful air-pump apparatus, is drawn out or exhausted—the stop-cock is turned—the globe is unscrewed from the air-pump, and placed in the hands of those who may consent to try their strength in pulling the two hemispheres asunder. Enormous is the force required; if the diameter of the circle be fourteen inches, the least force that will separate them will be equivalent to half a ton.

Such, then, being the pressure of the atmosphere, as is clearly proved by simple experiments, it may at first create some surprise that

the human body is capable of sustaining it without being crushed; that the tiny insect, with its delicate wings—and in some these amount to several square inches of surface—is not reduced to atoms. But the wonder will cease, when we reflect that this pressure, or a pressure little short of it, is essential to the existence, not of man only, but of all terrestrial organic beings.

Dr. Robinson justly observes, that "the human body (he might have said every organic body) is a bundle of solids mixed with fluids, and there are few or no parts of it which are empty. All communicate either by vessels or by pores, and the entire surface is a sieve, through which the insensible perspiration is performed. The whole extended surface of the lungs is open to the pressure of the atmosphere; everything, therefore, is in equilibrio; and if free or speedy access be given to every part, the body will not be damaged by the pressure, however great, any more than a wet sponge would be deranged by pressing it to any depth in the water." *

On this we would remark, that the human body, and that of terrestrial animals in general, is not adapted for the pressure of water at great depths; even could man by any contrivance breathe, such a pressure would destroy life; and, indeed, few aquatic animals are constituted for oceanic existence in the depths of the sea. While the surface is

* Mechanical Philosophy, vol. iii. p. 54.

alive with its myriads, the depths are still and untenanted; while bays, shores, reefs, and sand-banks, covered by many fathoms of water, are teeming with shelled mollusks, fishes, and thousands of wondrous creeping things, the profundity of ocean is a comparative desert; whatever lives there must be so constituted as to sustain a tremendous amount of aqueous pressure. Indeed, whales, which often plunge to a considerable depth, and remain submerged for twenty minutes, during which time respiration is suspended, are provided by their coating of blubber, and by the peculiar arrangement of their arterial and venous systems, for the pressure they then undergo; but this pressure often repeated, as it is when the animal is wounded and hard driven, soon produces great exhaustion. Captain Scoresby, for example, harpooned a whale, which, on receiving the weapon, descended four hundred fathoms, at the rate of eight miles an hour; but these animals, when suffering from the torture of the harpoon, often descend to a much greater depth, and sometimes strike so violently against a hard bed of the ocean as to fracture their jaws. At the depth of eight hundred fathoms, captain Scoresby calculates the pressure at 211,200 tons. On the other hand, the organization of man (and other animals) is as ill calculated for a much lighter pressure than that of our atmosphere at sea-level, as it is for great pressure in the depths of ocean.

In proportion as we ascend the alpine eleva-

tions of our globe, or mount upwards in a balloon, we find the air more and more rarefied. These elevations are, however, but trifling; nevertheless, trifling as they are, what an effect the decrease of pressure produces on the human frame! The heart beats with violence, the lungs gasp for more air, they have not pressure enough; the blood begins to ooze out of the minute vessels ramifying through the tissue of their delicate cells; blood issues from the nose, the eyes, the ears; the slightest exertion becomes oppressive—a mile or two higher, and death is inevitable. The difficulties attendant upon the ascent of Mont Blanc, the vast Himalaya chain, and the heights of the Cordilleras, are quite as much connected with the state of the air as with the terrible ravines and precipices which obstruct the way. Indeed, as is well known, on the elevated plateaus of South America or Thibet, men and animals accustomed to low plains, or even to gently undulating grounds, are for a long time distressed for breath, and incapable of bodily exertion. Time alone habituates them to the rarer and lighter atmosphere. But what is an elevation of 13,000 or 14,000 feet, nay of 15,668 feet, (Mont Blanc,) of 25,747 feet, or 28,077 feet, (Jewahir and Dhawalagiri, peaks of the Himalaya,) to that of twenty or thirty miles? At an elevation of twenty miles, the heart of a human being would burst, his lungs become gorged with blood, from every pore of his body a sanguine stream would gush forth—he would

immediately die. Is not, then, the pressure of the atmosphere necessary for the existence of man, constituted as he is for the planet which he inhabits? But the atmosphere, with regard to its relationship to the solid globe it environs, demands a few words.

This elastic fluid must be considered as a body of air revolving with the earth, whence it must be evident that the velocity of the strata of air, if we may use the word, increases as we recede from the earth's axis; for example, at the equator, that stratum of air, (if such there be,) which is twice as distant from the centre of the earth as the surface is, must revolve with twice the actual velocity of the air at the surface. Taking this fact into consideration, it results that, however attenuated, however rarefied, the atmosphere cannot extend beyond 20,000 miles from the surface of the earth; far above that elevation the centrifugal force would counteract the centripetal, or, in other words, the tendency of the particles to the earth would cease, and, consequently, unless air pervaded the universe, which is not the case, 20,000 miles are within the utmost range of possibility. The fact, however, appears to be demonstrated, that the limits of our atmosphere do not exceed an elevation of above forty-five or fifty miles, and that beyond this there is no refraction or reflection of the solar rays—that, in fact, air ceases. The finite extent of the atmosphere has been ably discussed by Dr. Wollaston,* his arguments being

* Phil. Trans., 1822.

based upon the *Atomic Theory* of matter. We may thus condense his train of reasoning, as far as it bears more immediately upon the present subject.—If air extend throughout the universe, we shall be obliged to admit that every planet must collect an atmosphere around itself proportionate to its attractive power. In this case, as he argues, Jupiter, at whose surface the force of gravity must be much greater than that of our earth, would certainly collect a large and dense atmosphere around him. The effect of the refraction of light through this atmosphere would become visible on the approach of the satellites to the planet, when they disappear behind his disc, and would cause a sensible retardation in their rate of approach. Now, it is allowed that no such retardation, even in the minutest sensible degree, can be observed, and hence it follows that Jupiter has no such atmosphere as that of our earth, nor the means of collecting it; consequently, air, such as that composing our atmosphere, is not diffused in any degree of rarefaction through the solar system. This finite character of our atmosphere is, as Dr. Wollaston contends, more conformable to the atomic theory than to that of the infinite divisibility of matter; since, in the first case, a boundary is possible, and will exist at the point where the weight of a single atom is as great as the repulsive force of the medium; while, in the latter case, it is difficult to see the possibility of any boundary.

By way of note we would here add, that the

theory of the *infinite* divisibility of matter, which all the laws of chemistry seem to deny, has no good grounds for our acceptance. God made matter, and, as we may humbly conceive, in the form of ultimate atoms, which, however inconceivably minute, must be definite—otherwise what is meant by creation? That which is created must have definite figure, size, etc., else it is nothing; and to talk of a creation where size of figures is absent, is absurd. We know that atheistical philosophers advocate the theory of the infinite divisibility, and infinite, essentially infinite duration of matter, for these points are steps to the theory of non-creation, or rather involve it. Infinite duration, infinite divisibility, infinite extension, and the plastic power of infinite time, together with the innate, ungiven laws of this infinite matter, form the key-stones to their unholy temple entrance. On this theory, worlds formed themselves, and harmonized with each other; living microscopic monads called themselves into being, and by voluntary exertion became developed through various phases into man. Thus, then, he owes no Creator thanks! Impious, irrational, debasing doctrine!

Supposing, then, that our atmosphere is not continued to an altitude exceeding fifty miles, forming a sort of circumambient ocean, at the bottom of which we live, and which is created for our peculiar organization, still it is not altogether improbable that some subtle ethereal fluid, altogether different from our atmosphere,

may extend itself throughout space—a fluid of extreme attenuation, the nature of which is to us unknown in fact—a fluid so impalpable as to cause no sensible retardation to the rate of motion in the planets.

We do not positively assert that such a subtle fluid exists, though many astronomers are in favour of this hypothesis; and, indeed, we believe that Encke's comet appears in successive revolutions to show in some slight degree the effect of some medium resisting its motion, and that the same observation applies to the comet of Biela. But when we consider the great tenuity of the substance of these comets, through which even faint stars may be seen, we shall be justified in regarding this resisting medium as being more subtle, attenuated, and elastic, than can be well expressed in words.

To revert now to our atmosphere, there is another interesting point which requires our notice; namely, are the constituents of this atmosphere chemically united together, or only simply mixed in certain proportions? We believe that it consists of a simple mixture only of two essential gases, or elements, namely, oxygen and nitrogen, with a small and variable quantity of carbonic acid, and also with water in a state of vapour. We may consider the last two as accidental ingredients, essential as the vapour of the atmosphere may be to the necessities of animals and plants, to luxuriance of scenery, and fertility of soil. The essentials of air are united in the following proportions,

namely, one part of oxygen and two of nitrogen, or one atom of oxygen and two atoms of nitrogen; but as the atomic weights of oxygen are as 8 to 14, the proportion of the weights of the two in any given quantity of air will be that of 8 to 28, or two to seven; in other words, nine grains by weight of air will contain two grains of oxygen, and seven of nitrogen, supposing the air to be pure.

But, as we have said, a portion of carbonic acid gas is usually contained in air; this gas is exhaled from the earth, and collects in certain localities, rendering the air more impure than it otherwise would be; as a rule, however, the quantity of this gas in intermixture with the air we breathe—its lower strata—varies from three to eight parts out of a thousand in weight; in its pure state, it is immediately destructive to animal life; but thus diluted is in this respect innoxious, while to the vegetable kingdom it is necessary. With respect to water in a state of viewless vapour, the quantum in any given weight of air seldom exceeds 1½ per cent.

Now if, as most philosophers of the present day seem to consider, there is no chemical union of the gases constituting the atmosphere, it may be supposed that, according to their respective weights, a partial separation and subsidence of the heavier will take place, while the lighter will chiefly compose the upper portion—thus, for example, a stratum of nitrogen will surmount a stratum of mixed nitrogen and oxygen, and this a stratum of mixed nitrogen, oxygen,

and carbonic acid. The following passage from the Penny Magazine will illustrate this theory: "A law is found to prevail in the mixture of gases and vapours, as universal as is that relative to their expansion arising from temperature, namely, that two gases in a state of mixture exercise no influence one upon the other, except communication of temperature, but that each is disposed in exactly the same way as it would be if the other were not present. Thus it is found, entirely contrary to all previous notions, that no pressure of dry air upon water exerts the least influence in preventing the formation of steam, which goes on exactly as if the space above were a vacuum, and continues until further evaporation is stopped by the pressure of the steam already created. It is found that no pressure of one gas can confine another in water; but that, supposing a bottle partly full of water, the gas confined in the water will escape to the surface, and distribute itself in precisely the same way as if the other gas were not present. By this it is not meant that the action, commonly called mechanical, cannot take place, or that a stream of hydrogen would not trouble the air; but only that the permanent settlement of one gas is not affected in any way by the presence of another, so long as no chemical action is excited.

"From this principle, Mr. Dalton,* taking into consideration the presumptions which exist against the chemical union of the ingre-

* Phil. Trans., 1826.

dients of the atmosphere, infers, that the atmosphere does not altogether consist of the compound called air, but that the nitrogen atmosphere is higher than the oxygen atmosphere. In fact, if there be no chemical union, the above law of the mixture of gases requires us to allow that each is an atmosphere independent of the other, and that the two are most probably of unequal heights. From some considerations into which we cannot here enter, Mr. Dalton thinks that the actual pressures exerted by the oxygen and nitrogen are in the proportions of the volumes occupied by them, that is, as one to four; and concludes that the oxygen atmosphere extends to thirty-eight miles in height, that of nitrogen to fifty-four miles, that of carbonic acid to ten miles, and that of aqueous vapour to fifty miles. It must be observed, however, that the state of the carbonic acid of the atmosphere is very variable; that there is not the same quantity by night as by day, in moist weather as in dry; and that the higher strata of the atmosphere contain more of it than the lower, which may arise from a rapid absorption by the earth.

"Against the hypothesis just described, it might, perhaps, be asserted, that the air which Gay-Lussac brought down from a height of more than four miles was not found to differ from that of the earth's surface in the proportion of its oxygen to its nitrogen, which would be the case if the oxygen atmosphere diminished in density more than in proportion to the diminution of that of the nitrogen, or *vice versâ*."

Without attempting to settle the question as to whether the component parts of the air are in a state of chemical union, or only in a state of simple mixture, of this we are sure, that the air is essential to the existence of all organic beings which live on the surface of our planet, that is to animals and plants, though the relationship of each to the air is diverse. The following comparison between the two great groups of organic creation, which we copy from an admirable paper on the Progress of Organic Chemistry in the "Companion to the Almanack, 1849," shows the respective relationships of animals and plants to the elements around them, as well as their mutual balance and dependence :—

An Animal is an Apparatus of Combustion.		A Vegetable is an Apparatus of Reduction.	
Burns	Carbon	*Reduces* ..	Carbon
,,	Hydrogen	,,	Hydrogen
,,	Ammonium.	,,	Ammonium.
Exhales	Carbonic Acid	*Fixes*	Carbonic Acid
,,	Water	,,	Water
,,	Oxide of Ammonium	,,	Oxide of Ammonium
,,	Nitrogen, or Azote.	,,	Nitrogen, or Azote.
Consumes ..	Oxygen	*Produces* ..	Oxygen
,,	Proteine	,,	Proteine
,,	Fats	,,	Fats
,,	Starch	,,	Starch
,,	Sugar	,,	Sugar
,,	Gum.	,,	Gum.
Produces ..	Heat	*Absorbs* ..	Heats.
,,	Electricity.	*Abstracts* ..	Electricity.
Restores ..	Its elements to the air or earth.	*Derives*	Its elements from the air or from the earth.
Transforms Organized matter into *mineral* matter.		*Transforms Mineral* matter into *organic* matter.	

Is not the wisdom of God here manifest?—The vegetable kingdom is made auxiliary to the animal, and *vice versâ*.—Yet, how? by mysterious changes, appropriations, productions, and consumptions, upon which modern researches are from time to time throwing new light; or, in other words, unfolding to us new revelations of the power and wisdom of the Great Eternal, who has condescended to give us a *spiritual* directory, a guide to our feet, and a lamp to our path, by means of which we, who at best only see through a glass darkly, may be led into that glorious world where there are no clouds—where there is no night—where there is "no need of the sun, neither of the moon, to shine in it: for the glory of God" doth "lighten it, and the Lamb is the light thereof."

2. *Its Electrical Condition.*—With the electrical changes in the state of the atmosphere are connected various transitions from heat to cold, dew, rain, hail, snow, clouds, winds, thunder-storms, auroræ boreales, haloes, parhelia, etc. In this point of consideration the atmosphere bears upon organic life. The solid globe itself may be regarded as a vast electrical or galvanic apparatus, and all the vital functions of animal bodies involve electric or galvanic phenomena. Magnetism appears to be essentially identical with electricity; both are most intimately connected with light and heat; and not only electric sparks, but all the phenomena of electricity, can be obtained from a common magnet. It is not here our purpose to enter

into a philosophical treatise on electricity and galvanism; a little consideration, however, will lead us to infer that the general diffusion of this subtle electric fluid, if the term fluid be at all applicable, is essential to the maintenance of organic life, and that electrical changes are perpetually taking place in organic bodies. This fluid is derived from the earth, or its circum-ambient atmosphere, and its currents obey definite laws, which have been elucidated by the experiments of some of the most profound philosophers of modern times.

After what we have briefly said respecting the electric condition of our globe, and the electrical phenomena which are involved in the processes of the vital functions, to say nothing of electro-magnetism, it must surely be apparent, that even as the air is in itself necessary to our existence, so the diffusion of that subtle matter, now quick, now slowly acting, now energetic, and now darting from the clouds to the solid earth a vivid flash, creating a momentary light in darkness—is equally essential; this is a point which, by the world at large, is but slightly taken into consideration. Remove this subtle element from the earth, and what would be the result? Perhaps the globe would deviate from her course; perhaps an alteration in her polar axis would take place. Perhaps—but why enter into such speculations? This is certain—animal and vegetable life, as at present constituted, could not exist: but all is ordered aright; the organization of matter, and the senses

of living beings, are involved in the presence of an element, variable, it may be, in its phases, but mighty in its effects. Here animals and plants play their part transversely, for each other's benefit; animals produce electricity, by means of the vital operations of their organization, and this produce, given to the earth and air, is abstracted by plants. They antagonize each other, and the result is harmony.

3. *Its Illumination.*—Light is evolved by and during the combustion of various bodies, as wood, coal, tallow, and spirits, or alcoholic fluids; it is the result of electricity—that is, of the electric spark or flash; it is evolved during many chemical experiments, and by the attrition of two quartz pebbles. The percussion of flint and steel produces luminous sparks; these sparks consisting, as the experiments of Mr. R. Hook have proved, of minute ignited globules of iron, struck off at the moment of percussion. These, and many other sources whence light proceeds, need not here be detailed; our object is with that general light, the light of day, which results from the influence of the solar rays. For the reception of pictures on the retina by means of the rays of light reflected from all things within the scope of vision, the eyes of animals are especially constructed. To some animals a dim twilight suffices, so far as regards their personal maintenance and their enjoyment of life; to a few the little light, which even in the darkest night is not absent, is all that is required

for their ordained habits and economy. In such instances, the retina is exquisitely susceptible, and the iris dilates to admit the entrance of every feeble ray reflected from the objects either of their search or avoidance. Often have we seen the owl, when twilight has melted into darkness, skimming over the fields, along the lane, and around the barn, quartering the ground in search of mice or moles, which, had they been at our feet, would to our eyes have been invisible. On the other hand, they would have been nearly, if not quite invisible to the owl in the full glare of sunshine. Yet, be it understood, light is as essential to the night-bird as to men, or the giraffe of the glowing wilds of Africa. We know not what *total darkness* is, unless perhaps we be walled up in a deep dungeon underground, to which light is utterly denied access; such living tombs have been contrived by the diabolical minds of tyrants, pagan and papistical. In the darkest night, even our eyes dimly discern the "form of things obscure"—things which, to a nocturnal animal, would be boldly conspicuous.

Light is a stimulus both to the animal and vegetable worlds. It is when daylight breaks that "man goeth forth unto his work and to his labour until the evening;" it is when light breaks that the feathered songsters of the grove join in one chorus of—why may we not say so?—instinct-urged thanksgiving. O man, gifted with reason! O man, the heir of immor-

tality! utter, then, thy song of praise, of gratitude, that the light of another day is bestowed upon thee; and then be diligent in all that God has called upon thee to perform, seeing that "the night cometh, when no man can work."

Light is a stimulus, more or less grateful to every living creature. Reader, have you ever wandered along the sea-shore, and explored the masses of rock left uncovered when the tide is fully out; there, adhering to the surface of the stone, in little ponds, miinic bays, may be seen scores of sea-anemonies (*actinia.*) If the sky be bright, there will they be, with their painted tentacles all expanded, animal flowerets feeling the influence of light; but let the sky change, let clouds obscure the day, and they retract their tentacles and shrink into repose. These animals have no eyes, but yet they are sentient of light. We mention these sea-anemonies merely by way of example; other eyeless, and we may say, apparently nerveless creatures evidently enjoy the influence of light, as the hydra, the medusa, and the polyps of corals.

If light waken up some animals from their repose — if it rouse the cock, and bid him sound his "clarion shrill," it warns others to retire to their obscure dormitory, and slumber till twilight recalls them into activity. The moth now flits abroad, and the bat and the fern-owl are on the wing, giving chase to their insect prey. The hedgehog is all alert, searching for slugs, worms, and various creeping things, which revel in the dews of sunset. It is

then, too, that the fierce prowlers of the forest issue from their lair, eager for blood; but when "the sun ariseth, they gather themselves together, and lay them down in their dens."

Light is not only a stimulus to animals, in the sense above noticed; it appears to be essential to health and vigour. Of this we are the less aware, because, under ordinary circumstances, we are always subject to its influence. Men have been confined for years in dark dungeons, and have reappeared upon the stage of life, pallid, meagre, weak, and emaciated beings, like breathing corpses; confinement, bad food, ill ventilation, and mental agony, had no doubt done their work; but want of light also had part in the sad devastation of the animal frame. Look, for example, at those parts of our bodies which are usually clothed, and compare the colour of the skin with that of the hands and face; strip the arm bare—the skin is acted upon by atmospheric air, but yet how much whiter than that of the hand, delicate as that hand may be. It may be said that heat, that is, solar heat, produces the difference. Partly so, no doubt, but not altogether. The face and hands of the Esquimaux are darker than his chest; moreover, suppose a severe and extensive cut happens, and that the wound thus inflicted is bound up for weeks by adhesive plaster, what do we see on removal of the straps and bandages?—a singular whiteness of the skin, the result, as it appears to us, of the exclusion of light from the covered

portion. Plants, as all must have noticed, have their leaves and flowers drawn towards the light, and become pallid when kept in dark places. Thus, for example, some flowers open only when the sky is clear, as the little pimpernel, the index of fair weather; others, as the sunflower, turn to the sun in his course from east to west; the eyes, or germinating stalk of the potato, though they shoot vigorously in the dark, are blanched; so are the covered leaves of endive, and the covered stalks of celery and sea-kale. Light is a chemical agent; light, as the apothecary well knows, greatly impairs the activity of the dried and powdered leaves of foxglove, and blanches castor oil. Light, therefore, is found to effect both chemical combination and chemical decomposition.

In nothing, perhaps, is the chemical agency of light more clearly shown than in the photogenic drawings, which are the fac-simile representations of objects delineated by the action of light on a thin sensitive layer of ioduret of silver. The following is the mode of preparing the plates for the reception of photogenic drawings, given in the Penny Cyclopædia:—These drawings "are produced on plates of copper, coated over with silver, which are found to answer better than such as are entirely of the last-mentioned metal. After being washed with a solution of nitric acid, the plate is put into a well-closed box, where it is exposed to the action of iodine, a small quantity of the latter

being placed at the bottom of the box, with a thin gauze between it and the plate. A layer of ioduret of silver is thus formed on the surface of the plate, and manifests itself by the yellow hue produced on the silver, which shows that the process of giving the plate the sensitive coating on which the action of the light delineates objects is completed. Thus prepared, the plate is placed within a camera obscura, of particular construction, and the delineation of the object is then effected in a very short space of time; but has to be afterwards brought out and rendered distinct by another operation, namely, submitting the plate to the action of vapour of mercury. Even then the process is not completed, for the plate has to be plunged into a solution of hyposulphate of soda, and afterwards washed in distilled water, which being done, the impression is fixed, and the plate may be exposed to light with perfect safety."* With reflection, refraction, and polarization of light, we have here no concern; therefore, interesting as the subjects are, we must pass them by.

Light radiates from the sun with almost inconceivable velocity; that is, at the rate of nearly 200,000 miles in a second. Hence it is about eight minutes in traversing the intermediate space between our globe and its starting point or origin. But here comes a question

* For further details, see the Handbook of Heliography, London, 1840; and (for preparing paper) the Visitor, 1839, p. 290.

not easily answerable. What is light? Is it matter? It is imponderable—can we conceive of matter without weight? Again, whence does it derive its velocity? The term radiation from the sun is convenient; but, then, what is radiation? Is there light, (and is there heat,) above the limits of our atmosphere? We cannot tell what the nature of the mysterious emanation of light and heat from the sun is, nor whether there are such phenomena as light and heat in empty space. Again, by what process is this enormous manufactory of solar emanation kept up? We may here lose ourselves in vague conjectures: He alone knows who said, "Let there be light: and there was light."

The few details which we have thrown together, bearing upon the natural light of our planet, derived from the sun, will suggest to the mind of the Christian those apt comparisons, of the broad light of day to the light of the gospel, transmitted to our souls from the Sun of righteousness. Till illuminated from above, man wanders in spiritual darkness; he sees neither the dangers that encompass him, nor the road by which he should go; he may have the light of nature and the light of science within him, but in spiritual affairs he is blind, and will be chosen only by the blind as a leader. Let, however, the light of revelation begin but to dawn upon him, and he learns to discover more and more clearly his real position, his true character, and the impossibility of his finding acceptance before God upon his own

merits. He feels himself to be a sinful creature, and is led to rest upon the merits and atonement of the Son of God, who died for our sins, and rose again for our justification. Thus enlightened, he receives strength to pursue his journey to that bright and glorious kingdom of which God himself is the Sun, and where there shall no more be night, where "everlasting day abides," and all is glory and refulgence.

4. *Its Temperature.*—Heat and light are distinct from each other, though in many cases one accompanies the other, and is produced by the same cause, as, for instance, by combustion, electricity, percussion, the sudden condensation of air, etc. Heat without light, however, is developed by the physical or chemical changes of bodies, as by the condensation of steam, and the admixture of water with sulphuric acid. It results, moreover, from the vital and mysterious operations which are constantly taking place in organic beings, and especially in the classes of mammalia and birds. But the great source of heat—that upon which the temperature of our atmosphere mainly depends—is produced by the influence of the solar rays.

There is, indeed, heat in the body of the globe itself; to say nothing of volcanoes, we may state, that the deeper we penetrate into the earth, the higher does its temperature become—a circumstance which has led many philosophers to infer, that the centre of our globe is in a state of incandescence. It is not here that we ought to moot this theory, neither shall we enter into

any speculations relative to the intrinsic nature of heat; like light, it is a mysterious agent or product, imponderable, yet subject to certain laws—laws which belong to a branch of philosophy into which it is not now our province to enter.

It may, however, be permitted us to state a few simple facts relative to the atmospheric temperature of our globe, and the adaptation of organic beings to the different degrees of heat within the inter-tropics, in the temperate and in the polar latitudes. Climate varies not only according to latitude, but also according to elevation, the relative proportions of land and water, the nature of the surface of the land, the extent of forests, etc. An island, for example, like England, surrounded by the sea, destitute of mountains of vast elevation, or of extensive morasses or forests, though lower in atmospheric temperature during the summer months than the parallel portions of the continent, has a milder atmospheric temperature during winter. The cold of North America during winter is greater than in the same parallels of latitude in the old world. Canada, for example, lies parallel to the northern half of Spain and France, (between 40° and 50° N. lat.) The severity of a Canadian winter is well known. At Quebec, the summer is that of Paris, the winter that of St. Petersburg. At New York, the summer is that of Rome, the winter that of Copenhagen. The same observations apply to the eastern portions of Asia. At Pekin, the

scorching heat of summer is greater than at Cairo, while the winters are as rigorous as at Upsal.

To the different climates of the globe certain plants and animals are especially adapted; organic existence ranges from the poles to the equator. How varied, how multitudinous, how wonderful, are the forms and structures of organic creation, from the moss or lichen, which creeps upon the surface of the rock, to the towering palm or gigantic oak—from the microscopic animalcule or puny insect, to the ponderous elephant or enormous whale! But, as we have said, every distinct region has, in a general sense, its own *flora* and its own *fauna*. It is in tropical countries, beneath a fervid sun, that vegetation presents us with its utmost magnificence. There we see forests of evergreen trees, palms, and arborescent ferns—there bloom flowers of gorgeous hue, and luscious scent—there ripen fruits of most exquisite flavour, attractive both to the sight and the taste.

It is there, too, that the elephant, the hippopotamus, and the rhinoceros, the largest of terrestrial quadrupeds, roam the plain, or wander in the dense forest; there are the birds conspicuous for the gorgeous splendour of their metallic colours, and the insects for their singular forms, their lovely painting, or dazzling effulgence. Receding from the inter-tropics, we find vegetation on a less magnificent scale; the trees are for the most part deciduous, various species

of corn are cultivated, the meadows are clothed with grass, and the vine and the olive flourish. Beautiful are the flowers, richly tinted are the insects; some few birds are splendid, but there are no sun birds, no humming birds, no birds of paradise. Receding further, we come to the extreme limits of the vine, and pass from temperate to colder latitudes, latitudes in which pines and firs form woods and forests, in which a scanty flora greets a tardy sun, in which the animals are covered with fur, increasing in thickness on the approach of winter. Beyond this territory the arctic regions open upon us. Yet even here vegetable and animal life meet us; but the species are few in number: the reindeer, the leming, the white hare, the musk ox, the polar bear, and arctic fox, are among the most remarkable. The birds are chiefly piscivorous, and all are migratory, passing southwards on the approach of winter. Coarse herbage, lichens, and mosses, vegetate during the fleeting summer, and lie buried beneath the snow during the winter. Yet are these animals and plants as well adapted for their dreary realms of snow and ice, as are the animals and plants of the rich inter-tropics for their luxuriant region. Take the elephant, the hippopotamus, the bird of paradise, or the glittering boa constrictor to Greenland, and they perish; take thither the graceful palm, palmetto, or pandanus, and they cease even to struggle for life. On the contrary, transport the polar bear and the reindeer to the torrid

plains of the inter-tropics, and their fate is sealed. The hardy plants, indeed, which endure the arctic regions, are, in many instances, at least identical with those that flourish in more temperate latitudes, but they are not to be found in the low sultry plains of the inter-tropics. They constitute the outskirts of northern vegetation.

The inter-tropical, the temperate, and the high northern regions of the globe, are characterised, then, by their own *flora* and *fauna;* but there is a distribution of organic life exclusive of latitude, which cannot but claim the attention of the naturalist. For example, the marsupial animals are distributed between Australia and central and southern America; but the American forms, very few in number, are essentially distinct from those of Australia. Again, it is to the warmer regions of the old world that the larger pachydermatous animals are confined, such as several species of rhinoceros, the hippopotamus, a tapir, two species of elephant, wild equine animals, as the dziggetai, wild ass, quagga, zebra, etc., and various species of wild hog. The living indigenous pachydermata of America consist of two species of tapir, and two of peccary. On the contrary, America is rich in the edentata, namely, sloths, ant-eaters, armadilloes, etc. The pangolins, however, (*manis*,) are found only in the warmer parts of the old world, and the aard-vark (*orycteropus*) is a native of South Africa. We might enlarge greatly upon these observations, and extend

them to birds and reptiles, etc., were it our design to enter upon the question; we shall only add, that in all regions animals are expressly suited to the climate of the countries in which they respectively live; they are constituted for the endurance either of heat or of cold, for self-protection against all extremes of atmospheric temperature, and for the enjoyment of existence, some under the equinoctial line, others within the arctic circle.

The foregoing observations do not apply to the human race. Man was ordained to replenish the earth; hence the pliability and energy of his physical constitution, which enables him to endure the heat of the inter-tropics, and the cold of Lapland or Nova Zembla—to dwell in the deep valley or on the lofty mountain. When we say this, we look at man as a species; we do not apply our remarks to individuals, or, in other words, we do not assert that a Samoiede would enjoy the heat of Ceylon or Sumatra, or that the Ceylonese would endure the rigours of arctic Siberia; we only mean, that the fact of hot and cold climates being inhabited by our race, proves that the physical condition of man can accommodate itself to every extreme of natural temperature upon our globe. It is true, that as a general rule man modifies his food, his clothing, and even the nature of his habitation, according to the temperature and products of the climate. The Laplander clothes his body in warm furs, the Ceylonese in a scanty vesture of thin cotton. Yet the wild Indians of some

parts of North America, and the natives of the dreary regions of Patagonia, are but loosely defended from the severity of the cold, either as it respects dress or their huts. The Scottish Highlander of the olden time, wrapped in his tartan, could sleep on the heather of the mountain side during a bitter sleety night without injury. After all, however, in the arctic regions the maintenance of life is a struggle; the depressing influences of cold, cheerless skies, and scanty food, tend to render the powers of the mind and the bodily frame alike stunted and undeveloped. Nature here holds out the means of life with a niggard hand, and it is from the sea principally that the supply of food and other necessaries are obtained.

On the other hand, within the tropics the means of existence are lavishly bestowed, the stimulus of animal food is not required, while the earth yields its vegetable productions in abundance; but in these regions, no strong motive stimulating to active exertion, the mental powers become enfeebled, and all those vices inseparable from habitual indolence are engendered. It is in the temperate regions, where nature is not lavish, but liberal, and yet requires the hand of labour and the head of thought, that the human race is presented to us in its highest form, whether bodily or mentally considered. It is in such regions that arts attain to perfection; that science walks hand in hand with religion. A thousand necessities urge to

exertion and enterprise, and these are followed by a due reward.

Thus, then, are organic bodies, plants, the lower animals, and man, affected by atmospheric temperature; but man has called in heat, artificially produced, if we may use the word in a certain sense, to his aid. Without heat, ore could not be smelted, or instruments of metal made; glass and earthenware could not be manufactured; houses could neither be built, nor furnished with articles of utility; the operations of agriculture could not be successively carried on, nor ships built, nor steam engines or machinery be constructed, nor could man clothe himself or cook his food. In short, were it to please the Almighty to suspend the laws of caloric, man would be rendered at once helpless, and his senses useless; he must necessarily become a completely altered being, granting even that his continuance as a species upon the face of the earth were guaranteed.

With what wisdom, then, are the laws of the Almighty framed! How happily do they all conjoin to fit this world for the exercise of our senses and our reason! Yet, how mysterious they are! We know not even what light and caloric really are; they are incomprehensible, and yet we experience their influence, and daily test their laws. Who, then, can wonder that the fall of man, the decrees of God, the advent of Christ, his Divine and human nature conjoined, his death as an atonement of inestimable value,

his intercession for all who come to him with faith, and the sanctification of the Holy Spirit, are each and all mysteries? "Canst thou by searching find out God?" Yet the believer knows *that* God to be his Father and his Friend; he walks by faith and not by sight, "by faith of Jesus Christ unto all and upon all them that believe," and are "justified freely by his grace through the redemption that is in Christ Jesus." When we reflect upon the mysteries of nature, let us also think upon the mysteries of grace; let the consciousness of our own ignorance lead us to throw aside presumption, and trust to the words dictated by Him, to whom all mysteries are open, and whose wisdom and goodness have no bounds.

5. *Its Dryness or Humidity.* — Evaporation from the waters of the globe, from seas, lakes, rivers, etc., is perpetually taking place, the ratio of evaporation being determined by the temperature of the atmosphere; that is, it increases as the temperature increases. Hence the actual quantity of water in a state of invisible vapour in the atmosphere will be the greatest when the temperature of the latter is the highest. Speaking according to our feelings, we then call the air dry, although, in fact, the quantity of water in solution in the atmosphere may balance the demands of the temperature.* But this invisible vapour is liable

* The quantity of water in solution in the atmosphere can never be greater than the quantity proper to the temperature; but it may be less.

from a thousand causes to condensation, dependent upon one law, namely, that when a portion of air, saturated with invisible vapour, is cooled below the point of saturation, a portion of the vapour becomes condensed, according to the degree of cold, so as to leave a due balance of vapour in the air, according to its altered temperature. Who has not seen the window-panes of a heated room in cold weather bedewed with trickling moisture? The vapour of the room is in abundance, although invisible; but certain strata of the air thus charged come in contact with the cold panes, and lose a portion of their caloric, and with their caloric a portion of their vapour, (to which, perhaps, the respiration of a large party has contributed,) and this becomes condensed in the form of a visible fluid. If we breathe against a cold pane of glass, we soon render it dim by moisture. On a hot summer's day, we do not perceive the vapour of our breath; but on a cold, clear, frosty day, a visible vapour or little mist is exhaled.

From electric changes, from currents of air, from sudden or gradual depressions of atmospheric temperature—be the cause what it may—the condensation of invisible vapour in the atmosphere is perpetually taking place. But the extent and degree of condensation is very variable. Sometimes, or rather very commonly, the quantity of water separated is small, and condensed into such minute particles that they float in the air, higher or lower, forming

wreaths of mist, or clouds of various patterns, density, and extent; sometimes they appear at a great altitude, like silvery waves, or snowy fleeces; sometimes at a lower altitude they take the shape of dense irregular masses, presenting to fancy's eye the outline of monstrous animals, of mountains, and castellated rocks; and sometimes the whole horizon is beclouded and dark; we then know that the condensation is increasing. What is the result? A fall of rain, snow, or hail, in which latter case the water is not only condensed into its ordinary form, but into pellets of ice. The water has passed through a stratum of air at the freezing point. Sudden hail-storms in summer may, we think, be classed among phenomena dependent on electric changes and operations in certain atmospheric strata.

We have here, then, two processes — one of evaporation, another of condensation; and these, by an express and admirable provision, have a constant tendency to limit each other's operations. Evaporation is increased by heat, but it produces cold in proportion to the rapidity with which it is carried on. Condensation is produced by cold, and at the same time heat is liberated.

How happens it that clouds and rain are formed in the higher regions of the air, and not closely round about us? In consequence of certain laws, the air incumbent on the earth's surface, especially in the hotter latitudes, is always under the point of saturation, the air

being really dryer than it is at a great elevation. These laws depend on the difference in the tension or elastic force of vapour at different temperatures; this elasticity increases rapidly from the temperature of 32° to 212°, the increase being in a geometrical progression, while the increase of the temperature of the air from a high altitude to the earth is in arithmetical progression. Now the air of our mixed atmosphere is the ingredient which controls the whole mixture. The result is, that the quantity of vapour present in a mixed atmosphere will, at any successive diminution of height above the surface of the earth, become successively less and less than that which would be required to saturate the air. The consequences of this result are most important, and are connected with our general well-being, and the due exercise of some at least of our senses.

The following passage from Dr. Prout's Treatise is so pertinent, that we beg leave to transcribe it: "Over the greater portion of the earth, the air which, during the day at least, is warmed by contact with the earth's surface, and thus becomes lighter, has a constant tendency to rise into the higher atmosphere. Now if this air were saturated with vapour, of course, whenever by rising it became mixed with colder air, its vapour would be more or less condensed, and a cloud would be formed. Hence, if we lived in such an atmosphere, we should be always enveloped in a mist, through which the sun would not be

visible. But, by the benevolent arrangement we enjoy, this consequence is so entirely prevented, that, unless under peculiar circumstances, and always for beneficial purposes, the air at the earth's surface is hardly ever saturated with moisture. The air which has been warmed by contact with the earth can, therefore, rise from the surface without any condensation of its moisture within the limits of its point of saturation. Thus, at the equator, before the air reaches the temperature of 61°, the presumed point of its saturation, it must ascend to the height of 6,000 or 7,000 feet. At this height its vapour will be condensed, and a cloud will be formed, which may either be precipitated on the spot from which its constituent vapour had risen, or may be transported by the currents of the atmosphere, similarly to refresh a distant country, or may again be dissolved in the air; while, under all these contingencies, the whole of the lower portion of the atmosphere is exempt from mist, and continues perfectly transparent. These operations are unceasing; moreover, the very clouds, by giving out their latent heat, and shielding the earth's surface from the direct influence of the sun, have a still further effect, and have a constant tendency to modify their own formation and existence."

We might here enter largely into other points of high interest connected with the science of meteorology, did the nature of our subject allow it. We do not forget that it is

upon the senses that we have to write, and accordingly we can go no further here than to show, in a brief and succinct manner, a few of the principal arrangements instituted by Almighty wisdom and power, which render our solid globe and its circumambient atmosphere the fitting abode of such forms of organic life as we are acquainted with, and for which, in fact, the world was created. To this world all the senses of animals are expressly accommodated. If there were no air, there could be no organs of hearing—granting the existence of living beings without respiration. If there were no light, or the laws of light were otherwise than what they are, our eyes would be useless. Were our lower stratum of atmosphere always enveloped in a dense mist, obscuring the rays of the sun, the sphere of our vision and its accuracy would be greatly circumscribed—nay, sounds would fall more dully on our ears. Suppose the globe closely shrouded by an oppressive fog; and then imagine the condition of plants, animals, and man. Yet, did it please our great Creator, it is in his power to call into existence plants and animals fitted for so moist and obscure an atmosphere.

Again, the atmospheric temperature, the varying degrees of heat and cold, according to latitude and to the characters of land—that is, its elevation, its depression, the nature of its surface, and the arrangement of adjacent seas, etc., are in harmony with the development of life, and the due exercise of animal functions.

Then, intimately connected with this subject, are the laws of caloric, the suspension of which would lead to the annihilation of all organic beings at present constituted. Neither can we forget the weight of the atmosphere, its varying electric conditions, nor the density and attractive force of our planet. To these, and many other laws impressed upon matter, and the results of those laws, are the physical organization of plants and animals adapted, each in its own way, but yet with a mutual relative bearing, conducive to universal order

To the constitution of this earth are plants, living forms destitute of feeling, hearing, sight, or indeed any sense known to us, adapted—yet according to their kinds they know what nutriment to refuse or reject; they are subject to the influence of temperature and of light and darkness; some court the broad glare of the sun, others flourish only in the shade. The same observations apply to certain of the lowest forms of animal organization, which lead a vegetable life, and appear not to be aware of their own existence. Nor, indeed, is it until we ascend high in the scale of animal being, and arrive at a point at which the senses are more or less developed, and in accordance with this development, that of mind also, (for we can use no other term,) that we discover a decided consciousness of existence, as manifested by anger, fear, and other passions; by watchfulness, sensibility to pain and pleasure of a mental kind; a recourse to artifice or to force as a means of

gaining certain ends; and other proofs of a something—call it mind, or any other name—to which the senses appeal.

For, let us remember, it is only in a certain sense that the eye sees, or the ear hears; in the former instance, nothing more than an image of objects is inversely reflected on the retina, and yet the mind recognises these objects in their proper position; and what is more, not double, though the same object is figured on the retina of each eye, or, in the case of insects, on the retina of scores of eyes. In hearing, the minute auditory nerves merely receive an impulse from the vibrations or wavelets of the elastic atmosphere, and this constitutes what we call noise, tones, music, voice. But these tones or noises are in the mind only; they are not appreciated by the exercise of any other sense.

Having thus briefly endeavoured to show the harmony of the general order of nature, as far as our globe and its animal and vegetable forms are concerned, we shall proceed to the consideration of another portion of our subject, and commence with it a fresh chapter.

CHAPTER II.

MAN'S KNOWLEDGE OF THE QUALITIES OF MATTER OBTAINED THROUGH THE MEDIUM OF THE SENSES.

If we reflect upon man, beginning with the savage, and ending with the philosopher, we shall find, that although the mental difference, or rather the extent of acquired knowledge possessed by each respectively, is very great, that the little the one possesses, and all that the other may boast of, are based upon certain simple principles, seized upon by the mind through the medium of the senses, and made more or less the subjects of consideration and research.

If the philosopher can display a mass of knowledge of which the savage is ignorant, the savage can show to the philosopher that his mind in some things is more ignorant than his own. Both have used their senses; both have examined and reflected; both have accumulated a store of information, which they turn to account: but the savage cares only for that which enables him to enjoy animal existence. He, therefore, investigates the habits of the animals around him, and the nature of the

plants; he tames some of the former, he cultivates some of the latter; he stores up provisions, he invents rude weapons; he builds kraals, or huts; he fashions boats, kajaks, or proas; he employs fire; and though he cannot discuss the laws of caloric, he knows many of them practically. In fact, his senses are to him the inlets of ideas, without any abstruse cogitation. He cannot but acquire knowledge through his senses, but he labours to acquire no more than is subservient to his present interest. To the philosopher, the senses are also the inlets of ideas; but then he is thereby led to abstruse cogitation, to experiments, and reiterations upon these, forming theories to be rejected or adopted, as laborious investigation may determine.

And wherefore?—Not contented with the vacuity of mere animal enjoyments, he antedates his spiritual existence, and while yet on earth soars to other worlds, or dives into the profound mysteries of nature. Between the rude savage and the philosopher there are innumerable gradations; yet the rude savage, if cultivated, might become the philosopher—and why?—Because, though mental powers, like bodily powers, differ, the mental anatomy, like the corporeal, is on the same plan; and, figuratively speaking, the muscles of the former may become by exercise as developed as the muscles of the latter. To what fields, then, of knowledge are the senses avenues—and avenues, because they are adapted to the condition of the globe we inhabit, and because the impres-

sions which they receive are seized upon by the mind, being there alone made palpable; and because the mind, by a reflex action, thence derives ideas, and combines and analyzes them.

The higher animals possess the same senses as man; and, it may be asked, Why do they not gain a similar knowledge to that which man acquires? We have already said, that the higher animals possess something which cannot but be termed mind, since they have passions and affections, memory, etc., which are qualities of mind, and not of matter. But, then, their mind is not only inferior in degree to that of man, but different in its anatomical construction. Certain animals, moreover, are inferior to others, and among animals of the same species there are different degrees of mental as well as of bodily force. Here, however, we can only generalize. Let it suffice, then, that we adduce for the purpose of illustration an animal with which we are all familiar—a domesticated animal, capable of a high degree of education, and which man has trained to the most various and opposite purposes—we allude to that attached servant of our race, the dog. Let it stand as a type of the higher quadrupeds.

That the dog remembers, and even to a certain extent reasons, cannot, we think, be contradicted. A shepherd's dog not only obeys its master's directions, but of its own accord will keep the sheep together, prevent them from wandering out of the right track, search for

them when buried in the snow, watch over them at night, and defend them against the incursions of the wolf. The sportsman's dog, when he sees his master take down his fowling-piece, examine the locks, and equip himself for the field, is quite aware of the result of these proceedings, and manifests unequivocal symptoms of pleasure. Dogs, moreover, may be taught to beg, to fetch and carry, to feign themselves dead, and continue motionless until the word of command be given, and to take their part in a scenic representation. There are, indeed, numerous authentic instances on record of dogs having acted with astonishing sagacity, and which prove not only memory, but a train of reasoning carried out with singular precision. In such instances, we cannot say that the animals are instinct-directed, because the actions performed are out of the common course of events, and are only occasional; every dog, under the same circumstances, would not act in anything like the same manner.

There are, however, bounds beyond which the most intelligent dog cannot pass; and why?—the anatomy of his mind is different from that of man. His senses, that of touch excepted, are as acute as those of man, some far more so, but his reasoning powers are confined within a small circle. For example, education does not really elevate the dog over the wild packs of his own species—it rather rivets the chain which binds him to man as

his lord; it enfeebles his instinct, and renders him at once more dependent and more useful; it places him in many different, and in a certain sense, unnatural spheres of action; it renders him a shepherd, a guard, a hunter, but it adds not positively to his information; he has no ideas of the beautiful or the sublime—of truth, of virtue, and vice—of humanity, pity, charity; he reflects not that death is his doom, even though he sees from time to time his companions expiring around him. It is, in fact, first, because the most elevated ideas or reasonings of the dog are merely simple, and those within a narrow compass; and, secondly, because the dog is utterly incapable of forming any abstract idea that education cannot elevate it above itself. It has not man's mental anatomy. The rudest savage can devise the bow, and the spear, and various other implements; he can fashion them because he has hands, but his hands are only the servants of his mind; had not his mind been what it is, his bodily organization would have been otherwise, but still in just harmony. In the savage lie the dormant germs of lofty intellect, and in his line, at some future generation, may a Milton, a Shakspere, a Newton, arise; sage poets, statesmen, and philanthropists, men of whom England boasts—England, whose children are the descendants of a semi-barbaric horde, which spread ruin in its westward progress.

But what the dog was in the earliest ages,

what it was in the times of classic history, that it continues to be; on the contrary, man can emerge from a savage to a civilized state; acquire new wants and supply them; improve upon first principles, and take step after step in the pursuit of knowledge; add improvement to improvement; begin by building a frail coracle, and then launch his steam-ship on the water—begin by erecting a low kraal, and then erect the palace of Cæsar, or the temple of Athens.

Reflex operations of the mind are denied to brutes—even to the dog, an animal which the Almighty evidently created for the special service of man: hence, though the avenues to their minds are the same, reason has but a feeble grasp upon the sensations which there enter; and that mysterious power, quality, or impulse, which we term instinct, rises predominant, and leads to operations which in man could only be the result of reflection and experience. Yet, as we have said, the actions of the dog, and we may add of the elephant, the horse, and other animals, are not all instinctive, neither do all the actions of man proceed from a train of reasoning, for some of his, even, are instinctive: the love of offspring on the part of the mother is entirely instinctive in its source.

It is, then, easy to see how it is that even the highest brute, with a mind limited as we have described, and with instincts which guide in the place of mind, can never improve or add to any store of knowledge, can never conceive one

abstract idea—such as eternity, infinity, matter, space, etc.—and can never investigate the laws of creation—can, in fact, be only what it is. The utmost extent of something like knowledge which the most intelligent and sagacious dog acquires, dies with it, and its successor has to learn all for itself. As for language, in the true meaning of the word, of what use would it be to brutes? Among the highest, as far as the necessity of communication extends, cries or modulations of tone and certain actions suffice to convey a distinct meaning; among the lowest, there is no necessity even for utterance, and there is no sense of hearing, nor even of vision. Language supposes a mind constructed like that of man, and as he emerges from a rude to a cultivated state, in like proportion will his language increase in copiousness and perspicuity, if not in force.

Let us here, without bewildering our reader in a maze of metaphysics, just glance at a few of the characteristics or faculties of mind, briefly anatomizing them, in order that we may clearly exhibit the mental distinction between man and the higher orders of beasts, by way of showing what the mind in each case derives from the inlets of the senses.

1. *A Knowledge of Self-existence, or Personality.*—This knowledge appears to us to be rather instinctive than the result of reflection, as some believe; we know intuitively that we exist, because we feel, because we see and hear, because we move, because we hope and fear;

nor will all the arguments which Berkeley or his disciples can adduce, convince any person that he exists only in idea.

That animals of the higher grades, at least, have this knowledge is very evident; gregarious habits, mutual recognition, the watch and ward system, characteristic of so many species both among mammalia and birds—a thousand circumstances which our readers may call to mind, prove it. We need not insist upon the subject. It is a feeling rather than a portion of knowledge; it is intuitive, and experienced alike by the ploughman at his work, by the horses who labour in the furrow, and the busy rooks which follow in their track. Where there is fear, or pleasure, or pain, or desire, there must self-consciousness be—a feeling of self-existence. We have no reason to believe that plants possess this feeling.

2. *Memory.*—Memory is a mental exercise, or faculty, of the greatest importance to man; it is in constant requisition; without it our intellectual improvement would be confined within very narrow limits. Our acquirement of language, and of the rules of sciences and arts, depend upon this faculty, and it is strengthened by habitual exercise. Between memory and recollection, there is a slight shade of difference. A man may say, "I remember the events of the year 1848"—"I recollect such an event, now that you mention it." Events may be recollected after being forgotten, and often are so in illness—nay, forgotten languages have

sometimes been fluently spoken. It often happens—why so, we cannot say—that circumstances or events, long passed from the mind, present themselves suddenly to it with extreme vividness, and are thenceforth remembered; but oftener does it happen, that the sight of some object, or that a sound, a note, a tune, a word, recalls to the mind forgotten events, bygone circumstances, hopes passed away, pleasures long fled, feelings long quiescent. This species of recollection has been called by some writers the "power of association." It certainly depends upon an association of ideas, which, on the key-note being struck, pass involuntarily through the mind; a sight or sound will often call to mind, with singular rapidity, a vision of other years, or of scenes far distant, towards which the heart intently yearns. Witness the effects of the air of the Ranz de Vache upon the Swiss soldiers in Napoleon's army. Recollection is often the result of attention. We remember a certain event, but forget the year in which it occurred; we direct our thoughts to the subject, we compare circumstance with circumstance, date with date, until at last—

"It breaks upon the mind, and all is clear."

That brutes possess memory is indisputable; indeed, we might fill pages with instances of the power of memory in animals, some rather startling; but as common every-day observation enforces the fact upon almost every one, we need not insist upon it. However, by way of

adding interest to a disquisition some may deem dry, we will introduce the following anecdote, related by Mr. Corse, in his Observations on the Natural History of the Elephant:* "In June, 1787, Fâttra Mungul, a male elephant, taken the year before, was travelling in company with other elephants towards Chittagong, laden with a tent and some baggage for our accommodation on the journey. Having come upon a tiger's track, which elephants discover readily by the smell, he took fright and ran off to the woods, in spite of the efforts of his driver. On entering the wood, the driver saved himself by springing from the elephant, and clinging to the branch of a tree under which he was passing. When the elephant had got rid of his driver, he soon contrived to shake off his load. As soon as he ran away, a trained female was dispatched after him, but could not get up in time to prevent his escape. She, however, brought back his driver, and the load he had thrown off, and we proceeded without any hope of ever seeing him again. Eighteen months after this, when a herd of elephants had been taken, and had remained several days in the inclosure, till they were enticed into the outlet, there tied and led out in the usual manner, one of the drivers, viewing a male elephant very attentively, declared he resembled the one which had run away. This excited the curiosity of every one to go and look at him; but when any person came near, the animal

* Phil. Trans., 1799.

struck at him with his trunk, and in every respect appeared as wild and outrageous as any of the other elephants. At length, an old hunter coming up, and examining him narrowly, declared he was the very elephant that had made his escape about eighteen months before. Confident of this, he boldly rode up to him on a tame elephant, ordering him to lie down, and pulling him by the ear at the same time. The animal seemed quite taken by surprise, and instantly obeyed the word of command, with as much quickness as the ropes with which he was tied permitted; uttering at the same time a peculiar shrill squeak through his trunk, as he had formerly been known to do, by which he was immediately recognised by every person who had ever been acquainted with this peculiarity." The same observer informs us, that another elephant, a female, taken in 1765, was turned loose in 1767, and retaken in 1782. She then recollected the customs and words of command learned during her former bondage; she laid herself down at the command of her driver, he fed her from his seat, gave her his stick to hold, which she took with her trunk, put it into her mouth, and returned it as she was directed, and as she had been accustomed to do.

3. *Attention.*—Attention is an abstraction of the mind from a multifarious variety of trifles, or circumstances, and an energetic direction of it to one subject, or object. In attention many, if not all, the senses may be engaged. For

example, a botanist gathers a flower; its beauty, the form and substance of its petals, their colour, its aroma, the honey-dew of its nectary, the peculiarity of its calyx, and other qualities, appeal to the mind through the senses of sight, smell, taste, and feeling. He has to describe this flower—he fixes his mind upon it, and puts forth a graphic delineation in apt and concise language. The ploughman is at work, and the sower of grain follows him—both give their whole mind to their duty. The critic (oh, word of fear!) gives his attention to the matter under his revision; and so does the cook, when preparing a *recherché* dish on the composition of which he prides himself. And does not the tiger, crouching in ambush, give attention to his object, stimulated in the meantime by hope? Who has not observed multitudes of cases, affording examples of attention in brutes? In fact, attention is a faculty displayed by all brutes, especially by those which lead a life of rapine, for upon its exercise depends their daily support. But man alone can direct his attention to things intellectual, abstruse, or religious. The reason is evident—the brute is incapable of abstract ideas, but quite awake to its own present necessities. The high realms of thought belong to man alone, of all terrestrial beings; but in how far higher a degree to those spiritual existences, those angels of light, which surround the throne of God, and who, contemplating with amazement the finished work of salvation, exclaim, "Worthy is the

Lamb that was slain to receive power, and riches, and wisdom, and strength, and honour, and glory, and blessing!" nay, till we mingle with these transcendent beings, the powers of our mind will be pressed down beneath a load of clay; then all that was dark shall be made clear, and with angels we shall join in saying, "Amen: blessing and glory and wisdom and thanksgiving and honour and power and might be unto our God for ever and ever!"

But we are told that there are angels "which kept not their first estate," and which are reserved "unto judgment of the great day;" namely, Satan and his apostate subordinates. Fallen though they be, their brightness "has not lost all its original splendour;" but they exercise their high powers in tempting and seducing to his eternal ruin man, whom Satan by his wiles has already crushed, and robbed of his original innocence. Let us strive against the tempter, the deceiver, who lays luxury, licentiousness, gold, fame, power, before his willing slaves, trying them on every point, and inducing too many to fall irrecoverably. But God's thoughts are higher than our thoughts, or than the thoughts of man's crafty adversary; and in wisdom he devised that mighty scheme, through which rescue and pardon are freely granted to all who accept the invitation of the Redeemer, "Come unto me, all ye that labour and are heavy laden, and I will give you rest;" "All," he says, "that the Father giveth me shall come to me; and him that cometh to me I

will in no wise cast out," John vi. 37. Jesus is the Conqueror, and death is swallowed up in victory. Flee, then, from the city of destruction; and though the slough of despond or the valley of humiliation be before, press forward, awakened sinner, to the heavenly Jerusalem! on that let your thoughts be placed.

4. *Comparison.*—The direct comparison of one object with another, with a view towards the acquisition of information, is exercised by man alone of all animals; but that superficial and involuntary comparison which leads to the simple *distinction* of things, as of land from water, or trees from houses, is common both to animals and man. *Choice* supposes the exercise of comparison in a low degree, and this a bird displays in the selection of a spot for its nest, and the beaver in that of a site for its dam and village. In both these cases, however, *instinct* impels to the labour, and supplies the place of experience.

5. *Knowledge of Cause and Effect.*—A knowledge of the connexion between cause and effect is the result of experience alone. We thus accumulate a number of facts, and by reasoning upon those facts, can infer with certainty what would be the result under such or such contingencies. That brutes gain information to a certain extent by experience is very plain. We have seen a monkey break nuts by hammering them upon a stone—we have seen the orang try to pick the lock of its door with

a bit of stick—we know instances of horses disengaging themselves from their headstall, unbolting the stable door, and making off to the pasture; a cat in our possession was accustomed to leap up and open the latch of the kitchen door, whenever she wished to enjoy a stroll. We might multiply examples, but so many will suggest themselves to the reader's mind, that we may spare ourselves the task.

With a knowledge of the connexion between cause and effect is associated that of *power*. Give me where to stand, said Archimedes, and I could move the world. Man's natural powers are very limited, but his comprehensive mind enables him to overcome the most formidable obstacles; to bore through the mountain, to uproot it from its base, and scatter its fragments over the plain; to over-arch rivers and arms of the sea with iron pathways; to travel as rapidly as most birds fly; to upheave ponderous masses of stone, and to compress light and flocculent materials until they become solid and heavy. But man accomplishes all this and far more, not by his own bodily powers, but by machinery of various kinds, and of various degrees of simplicity or complexity; nay, he cannot even cultivate the soil, except by the aid of implements, that is, simple machines.

Brutes entirely depend upon their own bodily powers, and gain a knowledge of the extent of those powers by experience. An old hunter will never attempt a leap which he

knows he cannot accomplish—a young, fiery horse will make a dash at it, and perhaps fail; if he succeed, his dependence upon himself will be confirmed; on the other hand, should he not succeed, it is more than probable that he will lose all self-confidence, and therefore be henceforward useless for the chase.

The elephant skilfully uses its tusks as levers, in the uprooting of trees; and when the megatherium and mylodon wrestled with the noblest productions of their primeval forests in South America, they applied in the best manner their forces and the means at their command. What is this but a knowledge (limited, we allow) of the relationship between cause and effect? The camel, when overladen, utters loud cries, and refuses to rise at the command of the driver; this was also a peculiarity of the llama, when that animal was exclusively the carrier of the Andes.

With respect to a knowledge of power, as regards ourselves personally, or as displayed by brutes, we cannot help thinking that much depends on an *instinctive perception*, added to, no doubt, by experience. All animals, from man downwards, apply their force according to their conformation; the horse kicks—the lion strikes with his terrible paw—the hyena seizes with his jaw—man uses his arms; but man also brings art to aid him in his bodily exertions. Hence the strongest man falls under the skill of the trained wrestler; but the contest of brutes is that of force. Hence it is that man

invents weapons which render the weak and the strong on a level, and which give to skill the predominance over force. This, too, implies a knowledge of the relationship between cause and effect, but a knowledge which brutes, if we except the chimpanzee, do not display. The chimpanzee, it is asserted, uses a club as a weapon, but we do not advance this as a fact positively established; indeed, we doubt it; we have never seen this animal use a stick, as we should use it in striking.

6. *Time.*—Man alone can invent artificial methods of measuring time; in an uncivilized condition he avails himself of the sun and moon, of the changes of day and night, of the tides, of the seasons, using them as natural chronometers. The higher brutes evidently possess some knowledge of time, as evidenced by the migration of birds, the relief of each other, as in the case of pigeons, at stated intervals on the nest, and, perhaps we may add, the storing up of food for future consumption. On this latter point, however, we will not insist, for most probably it is the result of an entirely instinctive impulse; we have known a caged squirrel make a hoard. The dog, says M. Ebzéar Blaze,* "reasons, calculates, knows how to count the days of the week, and even those of the year. Thus, for example, a dog belonging to M. Roger went every Saturday, at two o'clock precisely, from Locoyarne to Hennebon, (a distance of three

* Histoire du Chien.

kilomètres ;) it set off in a straight line to the butcher's, because that was their day for killing, and he was certain of having a good regale upon tripe. He was capable, then, of counting the days, since he never left home except on the Saturday. At the house of the same M. Roger, family prayer was kept up every evening, and the dog listened to the service tranquilly, but, as may be supposed, impatiently, for as soon as the last *paternoster* was commenced, he rose up and placed himself near the door, in order to make his exit immediately on its being opened."

We do not pretend to say that all animals calculate time, or that any have the power of calculation which man has ; and as for any abstract idea respecting time or eternity, it is out of the question. Hence they neither look back upon time, nor forward into the future. Their measure of knowledge is wisely allotted to them ; it is in due accordance with their animal wants, and final destiny ; but man, the heir of immortality, destined to exist throughout eternity, is so mentally gifted as to be able to think and reflect upon the past, the present, and the future. Were he not immortal, he would never, perhaps, have been endowed by his Maker with the idea of a future life. However this may be, the Holy Scriptures assure him of a life to come, and for which he must prepare himself only by one way. The hopes of the idolater are false.

Oh, then, how desirable it is that a knowledge of the true way of salvation should be spread throughout the world; that error and superstition should be banished; and that the light of the gospel should cast its heavenly radiance over the benighted regions of the earth!

7. *Locality.*—A knowledge or perception of locality, that is, of one place as distinct from another, is regarded by some as a result of the agency of an exclusive mental power; but for ourselves, we see in it only the exercise of attention, leading to distinction, and involving the aid of memory. To attempt to prove that man is endowed with this capability is useless; so is the dog, so is the cat, so are all our domestic animals. Attention, distinction, and memory, are exercised by the carrier-pigeon; when let free, at a long distance from home, it returns, and rests on its old abode. But what are we to say in the case of other animals, as the dog, the cat, and the horse, travelling back from a great distance to their home, without having gained the experience of the pigeon by soaring aloft, and surveying a wide extent of land below? It is well known that year after year the swallow and the martin, and other migratory birds, return to the same spot, in order to rear their brood. Swallows and martins have been marked, so that there could be no possibility of mistake. These birds take their departure in autumn, journeying southwards; they then traverse Europe, and cross the Mediterranean; they winter in

the warmer regions of Africa, and on the return of spring they commence their northern flight. What directs the course of a particular pair of swallows from central Africa, over land and sea, to a particular cottage or barn in Middlesex, Surrey, or Berkshire? Again, with respect to the bee, which wanders miles away from its hive, visiting fields and gardens in quest of honey—how is it guided in its outward and homeward flight? Has it landmarks? —does it know each wall, each hedge-row, each tree, each garden and field over which it passes? If so, how do the bees find their way to and from the floating apiaries on the rivers, through various parts of the European continent, and also in Egypt, the resting-place being continually changed according to the judgment of their owners? In Egypt it is the practice to transport the apiaries to distant places, in order to take advantage of the succession of flowers. "In Lower Egypt, for example, about the end of October, the bee-keepers embark on the Nile, and migrate with them to Upper Egypt, calculating to arrive there when the inundation is rapidly subsiding, and the flowers are beginning to bloom. Having stayed a short time in one place, till they suppose that the bees have collected all the honey and wax of the district, they remove two or three leagues lower down, and so on, as the plants come into bloom. Thus gradually returning homewards, they collect the honey of the adjacent country; and about the beginning of February,

having travelled the whole length of Egypt, arrive at the spots whence they had set out, and at their habitations. Niebuhr saw, between Cairo and Damietta, a collection of four thousand hives, in their transit from Upper Egypt to the Delta."* How do the bees, their locality being thus changed from time to time, find their way, not only to the boat of hives, but to their own peculiar hives respectively? There are points in the economy of animals which we cannot fathom, and it is better to confess our ignorance than to attempt a puerile theory. To speak truly, we cannot answer the question.

8. There are certain qualities of mind, certain principles which, whatever doubt may be held respecting our previous observations, at once distinguish man, and elevate him far above the highest brute. In fact, they take him out of the pale of the brute creation, and isolate him amidst the living creatures by which he is surrounded. He is the only animal being who can form any idea of God and his attributes, of eternity, of virtue and vice, of justice and mercy; in his breast alone are implanted conscience, faith and hope, repentance and spiritual peace. Herein have we an argument, to prove that man is not made to begin and end his career on this world, beautiful as it is, and fitted to meet all his animal powers, senses, and enjoyments. Why, indeed, should these principles be implanted in man—prin-

* Nat. Cyclop.

ciples immediately bearing upon a future state of existence, if that future state were not ordained? Where in creation can a similar anomaly be demonstrated? Every brute is gifted with vital functions and organization fitted to its destined mode of life, and with a kind and degree of mind (where this is needed) in exact accordance thereunto. Beyond this all is blank; indeed, the most wonderful works which brutes perform, and which in man would argue great thought and experience, are in them the result of instinct alone. The beautiful corals and zoophytes, which we so much admire, are instinct-built tenements. Instinct teaches the bee how to arrange her waxen cells, and load them with honey as a provision for the winter, and the bird how to build her nest. On the contrary, the operations of what may be called mind, in contradistinction to instinct, are displayed only by the higher brutes, and, moreover, are limited within narrow bounds.

We have heard persons assert, that a dog manifests the workings of conscience, because it often betrays itself by its timid, irresolute manner after pilfering, as if conscious that it had done wrong. The fact is, that the dog is conscious of no moral guilt; it has been previously punished for a like offence, and fears a repetition of the punishment; this is the solution of the whole affair.

We have so far shown the great superiority of the mind of man above that of even the highest brutes, and not this only, but its

essential differences, thereby rendering its possessor, indeed, the paragon of animals. Let us now endeavour to explain what information is gained by him from the exercise of the senses.

In speaking of God, and of celestial beings, we always use, and cannot but use, language drawn from the properties, qualities, and appearances of things around us, or from the passions of our own minds, or from the configuration and actions of our own bodies. We cannot, in fact, conceive of God except figuratively—hence to the limit of our intellect is the language of Scripture adapted. Though written under inspiration, it was written by men, and for men; and, therefore, the personification of the Almighty is unavoidable. It is said, "Thy way is in the sea, and thy path in the great waters, and thy footsteps are not known;"* we talk of the "work of his hands," of "the arm of God," etc., and we know that we are speaking figuratively, and it is because we know this, that we turn with disgust from the pictures, however elaborate, which, painted by Roman Catholics, represent the God of heaven and earth under the similitude of an aged man, with a long beard, and white hair, looking down from the clouds. We know that "God is a Spirit," but we have no conception of what a spirit is; we know nothing of spirit—nay, we know nothing of matter essentially; it is only of some of its properties that our senses afford us

* Psa. lxxvii. 19.

information, and it may have many properties for the discernment of which no senses have been bestowed upon us. Well, then, may it be written, "Canst thou by searching find out God? canst thou find out the Almighty unto perfection?"* We cannot, however, doubt, that the Almighty has given to us a mind and senses quite adequate, not only to our animal wants, but to our spiritual pilgrimage through this transitory scene, until we arrive at those realms of bliss, where ignorance shall be exchanged for knowledge, and every difficulty cleared away.

Considerations like these add interest to the inquiry—What variety and extent of information do we, as intellectual, immortal beings, gain through our senses? A little thought will convince us that, without the reflective agency of our minds on the impressions received by the senses, and the power of conceiving abstract ideas, the simple impressions of colour, solidity, weight, sound, flavour, or odour, would be but meagre sources of knowledge. As it is, they are the broad inlets of knowledge. Let us take them in succession, commencing with a new chapter.

* Job xi. 7.

CHAPTER III.

THE SENSES, AS THE INLETS TO KNOWLEDGE—SIGHT AND HEARING.

1. *Sight.*—The information acquired by the mind through the sense of sight is more varied than that communicated through any other sense, singly taken; but it is less accurate. The sense of sight requires education and assistance, and both are given through the sense of touch. We have already said, that light radiates from bodies, and forms a picture on the retina, (a reversed picture,) conveying to the mind certain qualities of matter, and, first—colour. By variations in the shades of colour, and by contrasts of colour, our eye, aided by experience from the sense of touch, determines the form of objects; and the boundaries of these forms we term outlines. All that we perceive is the limits of differently coloured spaces. Where, however, colours blend gradually into each other, the limits of each space, and, consequently, its outline, are indefinite; we do not see matter, but a quality of matter. There are circumstances under which the eye is deceived respecting colour,

two or more different colours producing a similar effect on the retina, and being undistinguishable from each other. Moreover, when the retina is fatigued by a prolonged impression from one colour, its sensibility to colour is diminished, and we cease to judge accurately; in these instances, the retina receives those only which are termed *accidental*, namely, which do not enter into the colour steadily gazed at previously. For example, "if we look steadily at a white spot, and afterwards turn the eye towards white bodies, a dark spot will be perceived by the eye. If we look at a red spot on a white ground, and then direct the eye to another part of the white ground, a green spot approaching to blue will be perceived. In the first case, the retina was fatigued by the white colour, and could not be excited by any other colour having the rays which constituted it in its composition. The *accidental* colour, therefore, was black. In like manner, after looking at the red spot, the retina was insensible to the impressions of a compound colour, having red rays in its composition. Hence, the accidental colour consisted of the other rays of the prismatic spectrum, forming a colour destitute of red."

The eye is subject to deception, or illusion. Sometimes we mistake the shadow for the substance. The rays of light, passing through media of different densities, are refracted at different angles; hence the direction or nearness of different bodies becomes apparently

altered, and experience alone corrects the error. On putting a pole or stick obliquely into clear water, the submerged portion seems to be bent at the surface of the water, and to rise higher in the water than it actually is. The bottom of a deep, clear river, or pond, seems to be nearer to the surface than it is in reality; in other instances, the water deceives by an apparent shallowness, the truth of which the inexperienced bather should always test before venturing in. If a gold or silver coin be put at the bottom of a basin, and the basin be then filled with water, and the eye be obliquely directed, so as not to see the coin, hidden by the rim of the basin, it will become apparent when the basin is filled. In spearing fish, allowance is made by the experienced for the difference of refraction of the rays of light in a rare and more dense medium. It is probable that birds which prey upon fish, by darting at them while at a certain distance under the water, as, for example, the fish-hawk, or osprey, and the gannet, are taught by *instinct* to correct an apparent error of sense, or rather, an illusion, which man corrects by practice and experience.

The eye is deluded by the mirage. The mirage (a French word, adopted into our language) is "the name given to a phenomenon of unusual attraction, for which we have no specific appellative, unless it be the sea-term *looming*. As a general definition, we may say, the mirage is an optical illusion, occasioned by

the refraction of light through contiguous masses of air of different density, such refraction not unfrequently producing the same sensible effect as direct reflection.

"The illusions of the mirage differ according to circumstances, but they may be all arranged under one or other of the three following classes: *vertical reflection*, *horizontal* or *lateral reflection*, and *suspension*."

In hot, flat regions, as certain portions of Arabia, Egypt, Persia, the western deserts of India, etc., the *vertical mirage* is extremely common; it presents the illusive appearance of a wide, clear lake, or sheet of water, in which trees, buildings, and other objects, seem to be reflected, and in a reversed position. On approaching this deceptive lake, it keeps receding as we advance, the reflected images vanish, to be succeeded by others, as they come in rotation into sight. And thus the wayworn and thirsty traveller across the desert is first cheated into hope, and at length mocked into despair. During the French campaign in Egypt, under Napoleon, the soldiers, who suffered extremely from the torments of thirst, were cruelly tantalized by the deceptive mirage. M. Monge, one of the savans who accompanied the army, thus comments upon this phenomenon: "The soil of Lower Egypt," he observes, "is a vast plain, perfectly horizontal, its uniformity being interrupted by a few eminences, on which, in order to secure them from the inundations of the Nile, the villages are built. In the morning

and the evening the aspect of the country presents nothing remarkable, all objects appearing in their natural positions, and at their proper distances; but after the soil has become heated by the rays of the sun, the prospect seems bounded by a general inundation. The villages at a little distance appear as islands in the midst of an expansive lake, and the image of each village is seen invertedly reflected, as if the water were real. As we advance, the mimic water retires, still reflecting image after image;" so that in this illusion the classic fable of Tantalus is represented; might not the fable have had its origin in the phenomenon of the mirage?

It is not, however, exclusively on sandy plains or in very hot climates, that this mirage occurs. It has been observed by Biot over the sandy beach of Dunkirk, and is not unfrequent along the coast of Calvados. A strange and beautiful effect of the mirage was seen by captain Maundy, at the Shallout Pass in India, and is thus described: "A deep precipitous valley, at the bottom of which I had seen one or two miserable villages in the morning, bore in the evening a complete resemblance to a beautiful lake. The vapour which played the part of water, ascended nearly half-way up the sides of the vale, and on its bright surface the trees and rocks were distinctly reflected."

How like the vanities and pleasures of earth is the mirage! Bright, sparkling, illusive—an appearance without a substance—a mockery

which deceives, attracts, and vanishes away! He who pursues the pleasures of this world, and all its tinsel gratifications, resembles the fevered traveller in the burning desert, who pursues the mirage, which recedes as he presses eagerly towards it, till at length, discovering its nothingness, he perishes.

We may next consider the mirage produced by *horizontal* or *lateral reflection.*

"In the horizontal or lateral reflections, the mirage represents the reflected image sideways. Thus, on the 17th of September, 1818, M. Jurine and Soret observed a lateral mirage on the lake of Geneva. A bark, about four thousand toises distant, was seen approaching Geneva by the left bank of the lake, and at the same moment there was seen above the water an image of the sails, which, in place of following the direction of the bark, receded from it, and seemed to approach Geneva by the right bank of the lake, the image sailing from east to west, while the bark was sailing from north to south. This lateral mirage is known to the inhabitants of Meroa, who call it *Si-koté*, (castle of the cold season;) by those who live on the plains watered by the Chumbul and the Jumna, it is termed *Dissaser*, (prognostic.)

"In particular situations, both the *vertical* and *lateral* mirage may be observed together. Thus the late Mr. Blackadder has described some phenomena, both of vertical and lateral mirage, as seen at king George's Bastion, Leith, which are very instructive.

"The phenomenon called *suspension*, which is the third kind of mirage, and to which the term *looming* is most strictly applied, is the picturing of an object immediately over it in the air, frequently without reversion of the image. Sometimes the objects are merely raised above the height at which, under ordinary circumstances, they would appear. Thus sir R. K. Porter mentions a phenomenon of suspension, or *looming*, in the plains near Bagdad. 'A little before morning,' says he, 'I observed an elevated stream of water, which, from its situation, must be the Tigris. Its surface was brilliantly illuminated by the moon, but the longer I kept my eye fixed on this noble river of many interests, the more my surprise became excited at the extraordinary height of its waters above the level of the desert, till at length I began to suspect that some optical illusion from refraction was assisting the apparent elevation of the stream; but I had not conceived the extent of the deception, for as the dawn advanced the phantom river totally sunk from my sight.' The phenomenon of *looming* is most generally observed at sea, or near the shore. At Reggio, in Calabria, the *Fata Morgana* (Fairy Morgana) is visible, which for many centuries astonished the vulgar and perplexed philosophers.

"It frequently happens that the phenomenon of the *vertical* mirage is combined with that of *suspension*, so as to show in the air both

a direct and an inverted image of the subject, the latter being undermost.

"Now all these phenomena, and their various modifications, depend on the different density of the lower strata of the air; and as this difference of density may be occasioned both by heat and moisture, and as heat may be reverberated from the mountain's side as well as from the horizontal surface of the plains, from the sea as from the land—and, further, as contiguous columns of air, as well as horizontal strata, may be of different densities, it is easy to conceive why the mirage may be seen in very different situations, as also why it presents such varied appearances. It will also be evident that any cause which re-establishes the equilibrium of density in the different portions of the air, must cause the illusions of the mirage to vanish."*

It cannot be doubted that those appearances, which sailors call *Cape Fly-away*, the *Enchanted Island*, and the *Flying Dutchman*, etc., are the effects of the mirage. They are the objects of superstition, and thus has an illusive appearance caused many a heart to beat with fear, which never so beat in the tempest or the sea-fight.

The eye assists us greatly, indeed almost exclusively, in determining the *motions* of bodies; yet in this we require experience, and after all we are frequently deceived. When a body moves in a straight line from us, we can-

* Penny Cyclopædia.

not tell whether it moves or not, and then only come to the conclusion that it recedes in consequence of its becoming more obscure, and from a change in its relative position to other objects which we know to be stationary. When we travel in a railway carriage, the banks, the hedge-rows, and the fields, seem as if gliding with extreme velocity away from us. It is only by a course of reasoning that we know such is not the fact; it is true that the course of reasoning is very short and simple, yet still that reasoning is requisite; indeed, it has been acknowledged only in modern times that the sun is stationary, and that the world moves. Bodies moving with extreme velocity produce a continuous impression on the eye; thus, for example, if a stick burning at one end be rapidly whirled, the burning end produces the appearance of a fiery circle. The spokes of a coach-wheel, rolling round very rapidly, present the appearance of an indistinct expansion. On the contrary, bodies moving with extreme slowness appear to casual observation as stationary; thus the act of growing, in ordinary plants and animals, is not appreciated, though the result is demonstrated in due time.

The eye, moreover, may be deceived by artificial representations, as by painting (take the Diorama as an example) or by models. We have seen flowers so truthfully modelled in wax that, by the eye alone, no distinction between them and natural flowers could have been detected.

The same observations apply to *magnitude* and *distance*. Objects of gigantic magnitude, as, for instance, the pyramids of Egypt, at first appear less than they are in reality ; and it is only by admeasurement, examination, and comparison, that the mind becomes impressed with the idea of their immensity. A building, the details of which are in just harmony, always appears to be smaller than it is, because no discordance betrays the vast preponderance of certain parts over the littleness of others. Habit, or, in other words, education, is essentially requisite to aid the eye in its appreciation of magnitude.

We may say the same with respect to *distance*. An infant does not distinguish between near and distant objects ; its eyes have yet to become educated, and so have those of adults placed in circumstances to which they are unaccustomed. For example, the walls of a city, reared in a vast level plain, and descried at a distance, appear to be far nearer than the traveller will find them to be ; again, when standing on the beach, we look at a ship in the distance, we are apt to think it closer to the shore than we should prove it to be were we to traverse the distance in a boat. A sailor would judge of the distance accurately.

How much the accuracy and utility of the eye depend upon practice or education may be illustrated by the case of a boy, who, as described by Cheselden, was born quite blind, but was suddenly restored to sight, at the age

of twelve, by the skilful removal of the cataract. At first, he was impressed with the idea that all the objects which he saw around him touched his eyes, in the same manner as in the act of touch they came in contact with the skin. He could neither estimate distance, nor distinguish one object from another, until he had applied the test of touch as a corrective and assistant.

It may here be asked, how the fact is to be explained that, though images are pictured on the retina inverted, we do not see them as such, but in their true position? When we say that the eye sees, we use popular, but not strictly correct language; the eyes are the organs or instruments of vision—that is, for transmitting certain qualities of matter to the mind; it is not the image on the retina which the mind contemplates, for we are utterly unconscious that such an image exists—it is the object itself. "To expect that the impression from an inverted image on the retina should produce the perception of a similar position in the object viewed, is to commit the error of mistaking these images for the real objects of perception, whereas they are only the means which suggest the true perceptions. It is not the eye which sees; it is the mind." "The analogy which the optical part of the eye bears to a camera obscura has perhaps contributed to the fallacy in question; for in using that instrument we really contemplate the image which is received on the paper, and reflected from it to our eyes;

but in our own vision nothing of this kind takes place."

We scarcely know whether we can place among optical illusions those strange apparitions of departed persons, of friends at a distance, or of singular and grotesque faces or figures, of which we have many authentic narratives. These we take to be strong impressions on the mind alone, (for no image can there be on the retina,) the result of some morbid condition of the brain and nervous system. Such was the evil genius which Brutus saw in his tent before the battle of Philippi, and such the air-drawn dagger of Macbeth—such also were the phantoms seen by Nicolai, the philosophic bookseller of Berlin, who has given an admirable account of his mental visions, referring them to their true source, at the very time that the illusions visited him. In some states of body, we see grotesque and ludicrous objects, while our eyes are shut, and, as we can testify, often not before we have shut our eyes, and thereby closed the door of access through those organs to the mind. What horrible phantasms terrify the unhappy sleeper labouring under night-mare! What strange things does the delirious sufferer mentally behold, and through what strange scenes, real to him, does he pass! We see, we converse, we laugh, we mourn, we feel pleasure and anguish, even in our dreams. These, then, are not optical but mental illusions—no figure is made upon the retina appealing to the mind, but the mind itself sees

things which are not, and is delighted or terrified by its own involuntary creations.*

In former times, craft, under the name of religion, availed herself of these mental illusions, and extorted gifts of lands and gold from the terrified, perhaps most guilty sufferer, in order that his peace with the church (so miscalled) might be made, and masses said for the repose of his soul. He was taught to buy his entrance into heaven—not with the Pearl of great price—not by presenting before the Judge of all mankind the merits and the atonement of the Messiah, but by founding a monastery, or by adding to its treasures and domains. His faith was placed, not on the promises of God in Christ, but on the promises of a mere mortal at best—yes, a mortal, who knew that while he promised he was weak as other men. In concluding our observations upon the sense of sight, we may refer to a few striking passages in Scripture, of great force, and well calculated to excite reflection. "He that formed the eye, shall he not see?"† No secrets are hidden from God; no, not the secrets of the heart, for these are written on a tablet which he, and he alone, can read. May our prayer be, "Let the meditation of my heart be acceptable in thy sight, O Lord, my strength, and my Redeemer!"‡ "Enter not into judg-

* See "An Essay towards a Theory of Apparitions," by John Ferriar, M.D., 1813; and "Sketches of the Philosophy of Apparitions; or, An Attempt to trace such Illusions to their Physical Causes," by Samuel Hibbert, M.D., 1824.

† Psa. xciv. 9. ‡ Psa. xix. 14.

ment with thy servant: for in thy sight shall no man living be justified."* In the sight of God, we speak figuratively, all men are sinners, and as sinners condemned; but God will not enter into judgment with those who, by faith in the atonement, looking to the Saviour, as the Israelites looked to the brazen serpent in the wilderness, turn away from their wickedness, and become examples "of the believers, in word, in conversation, in faith, in purity."

2. *Hearing.*—What we call sound, noise, or tone, is a mental appreciation of the effects of the tremulous or vibratory motions of the particles of an elastic fluid, such as air or water, on the auditory or acoustic nerves of the internal ear. Sonorous vibrations are produced by the concussion of hard bodies, by the bolt of lightning, by the vibrations of stringed instruments of music, by the forcible current of air thrown into the tubes of wind instruments, and by the air driven from the lungs through the organs of voice in reptiles, birds, and mammalia. There are, indeed, few movements, few collisions, few atmospheric disturbances, which do not excite those tremulous wavelets of atmosphere, those oscillations, which produce in us the sensation of sound. In fact, during the day, the sense of hearing is as perpetually employed as is that of sight; yet, strange to say, from the impressions made through the medium of both these senses, we can so far abstract the mind, and throw it

* Psa. cxliii. 2.

upon its own internal reflections and operations, as to see without discrimination, and to hear without attention or notice.

As sound is the result of the tremulous fluctuations of air, it will not surprise our reader to know, that no sound is conveyed from the percussion of bodies in a vacuum. The experiment of suspending a bell in the exhausted receiver of the air-pump, and causing the clapper to strike it as when rung, has been very often repeated; no sound is communicated to the listener, although the vibrations of the bell are clearly perceived; should a little air be now admitted, a faint tinkling is heard, which becomes stronger in proportion to the admission of air, until it is natural; on the contrary, if the receiver be filled with greatly condensed air, the tinkling of the bell is louder than it is when in an atmosphere of the ordinary degree of density.

Sound, or, rather, the wavelets of the atmosphere producing this sensation, radiate from the sound-causing object in all directions; these wavelets, however, extend only to a certain distance, according to the violence of the central agitation; they become gradually feebler and feebler, and at last die away. Thunder, the firing of cannon, and the clang of trumpets, are not heard beyond a certain distance, and even at that distance, whatever it may be, the ear only faintly distinguishes the report, for the vibratory action and reaction on each other of the atmospheric particles, become

feebler and feebler in proportion to the aërial distance of the listener.

If we stand on an eminence commanding a view of a number of cannon, say a mile distant, which the soldiery are from time to time firing, a decided difference of time will be perceived between the flash and the report; the same observation applies to lightning, a considerable interval often occurring between the flash and the thunder. Hence, light is said to travel faster than sound. Sound travels at the ratio of about twelve miles and a half in a minute, but its velocity is greater in a denser than in a rarer medium, as is also the distance to which it is propagated. These points are illustrated by a comparison of water with atmospheric air. All aquatic animals are not constituted for hearing; myriads, indeed, have neither sight nor hearing. By the cuttle-fishes (*cephalopoda*) both these senses are enjoyed as well as by fishes, aquatic reptiles, and we need not say by such aquatic mammalia as whales, grampuses, porpoises, etc. To them the water is the medium of sound, and granting that their auditory nerves have the same sensibility as those of man, they will hear sounds not only more quickly, more distinctly, but at greater distances. This is accounted for by "the greater elasticity of the constituent particles of water, within the minute distance required for their action in propagating sound. Stones struck together under water are heard at great distances by a person under water. Franklin

found, by experiment, that sound, after travelling above a mile through the water, loses but little of its intensity. According to Chladini, the velocity of water is about four thousand nine hundred feet in a second, or between four and five times as great as it is in air."

Different bodies conduct sound to the ear with more or less distinctness, according to their susceptibility for vibrating, and also with more or less rapidity. Ice, for example, conveys sound more speedily than water, and far more rapidly than air; thus, if a cannon on the edge of a frozen lake be fired, a person on the opposite side will find the flash to be followed by two reports, the first conducted to him by the ice, the second by the air. If a long steel rod be applied to the orifice of the ear, the gentlest jar given to its further extremity, and which, but for the intervention of the metal, would not have been audible, produces a strong and distinct impression. Cotton wool, sheeps' wool, and soft stuffs, generally are bad conductors of sound. The frozen earth conducts sound from great distances; the approach of a horseman in clear, frosty weather, will be heard at a far greater distance than when the ground is moist, or not hardened; in the former case, indeed, a double sound may sometimes be heard, one produced by the vibration of the ice-bound earth, the other, if distance allow, by that of the air.

The distance to which sound can be conveyed through the speaking-trumpet is very

surprising. The invention of the modern speaking-trumpet is generally accorded to sir Samuel Moreland, (1670,) and some of the large brass trumpets, made under his direction, carried the human voice from a mile and a half to between two and three miles distance. The efficiency of this instrument has been attributed to the repeated reflection of the sound, or waves of air, (like rays of light,) from side to side along the course of the tube, their ultimate efflux from the mouth of the instrument being in such a way, as either to cause the rays of sound to be collected into a focus at a distance, or to be projected forward in parallel lines, instead of allowing them to diverge in all directions, and on these principles various modifications in the form of the speaking-trumpet have been suggested.

The views, however, of professor Leslie do not coincide with this theory. "The performance of the speaking-trumpet," he says, "does certainly not depend upon any supposed repercussion of sound; repeated echoes might divide, but could not augment the quantity of impulse." His idea is, that "the tube, by its length and narrowness, detains the efflux of air, and has the same effect as if it diminished the volubility of that fluid, or increased its density." "The organs of articulation," he adds, "strike with concentrated force; and the pulses thus so vigorously excited are, from the reflected form of the aperture, finally enabled to escape and spread

themselves along the atmosphere." The experiments of Hassenfratz, a French philosopher, are cited in support of this theory. He tried the power of a speaking-trumpet, by measuring the distance at which the ticking of a watch could be heard through it, and found the effect the same, whether the metal tube were used simply, or wrapped round in such a way as to prevent vibration. It was also heard at the same distance when the inner surface was lined with linen, or woollen cloth, to diminish reflection; and the range of a cylindrical trumpet was the same as that of a conical one.

In the ear-trumpet, used by persons partially deaf, and in the stethoscope, it appears to us that we have concentrations of sound into a focus, by repeated reflexions of the aërial wavelets from side to side of the tube; and we may ask, does not the murmuring sound which we hear, when we apply a conch shell to our ear, arise from the same kind of percussion?

In echoes we have an instance of the reflection of atmospheric undulations, and this reflection, as in many natural situations, may be multiplied till the last faint repetitions die away; and when a succession of echoes is very rapid, a loud exclamation of the monosyllable, Hah! may be thrown back upon the ear like a boisterous laugh. The echoes of old halls and galleries, of vaults and dungeons, of caverns, rocks, and grottoes, have served as subject-matter for the writers of imaginative

poetry and romance. It is not only to old romantic halls and galleries that echoes are confined; they are not uncommon in modern public buildings, so that the speaker hears his words repeated. "The distribution of sound in public edifices, so that the echoes (or reflections of aërial waves from the walls, etc.) may be most advantageously brought to strengthen the original sound, is a subject deserving of much attention." For some observations on the errors of architects on this point we may refer to sir J. Herschel's Treatise on Sound.

When our auditory nerves receive a succession of uniform impulses at equal intervals of time, the intervals being at the same time very small, the impressions become so interblended with each other as to produce an apparently continuous sound, even and equal, except as to variation in loudness. This sound we call a musical note, produced by the string of the violin, or piano; if the intervals between the vibrations be, comparatively speaking, long, the note is grave; but if within the same given time the vibrations be very numerous, the note is in proportion acute. Some notes harmonize with each, and thereby please the mind through the ear; others are discords, and offend. Grave or acute notes depend upon the length and the tension of the strings of an instrument, or the length of a wind instrument. In the piano, the low notes are produced by long, thick strings, the high notes by slender, short wires, in which the vibrations are exces-

sively rapid. In the violin, which has strings of equal length, the thin strings for producing the high tones are screwed to a far greater degree of tension than those of the lower tones; and each string, as its length (that is, vibratory length) is shortened by the pressure of the finger at due intervals, produces high and higher tones in proportion.

We have here said enough (for we aim not at a treatise on acoustics) to show what sound really is, and what are the principal laws by which it is governed. We have also shown, that it is our mind alone that takes cognizance of the impulses given by vibratory wavelets of the atmosphere to the auditory nerves; consequently, that as the mind sees, so the mind alone hears, for vibration cannot in and of itself be that sensation which we call sound.

What is the knowledge gained through the ear by the appreciation of sound, or in common language, by hearing? Let us answer:— We commonly judge of the distance and position of objects producing sound by the sense of hearing, but in these points our accuracy greatly depends upon our attention and our experience. Yet are we liable to deception; we are thoroughly deceived by a skilful ventriloquist, who can so modulate his voice as to make it seem distant or near, or to proceed from one quarter of the room or house, or from another. The voice of the corn-crake (*Crax pratensis*) is, from some cause or other, very perplexing; sometimes it will appear as if the

bird were only a few yards distant from us, and the next instant in some far part of the field. Perhaps instinct leads it to alter the pitch of its monotonous cry, in order to deceive the intruder. Again, echoes deceive the ear ; not only may we mistake echo for the actual voice of the speaker, but it may appear as if close or distant, faint or loud, and thus in every point lead to erroneous conclusions.

That the ordinary animals around hear will not be denied, nor can we blind ourselves as to the fact, that they acquire a limited share of information, bearing upon their corporeal necessities, through this sense. Animals have a natural language, expressive of pain or pleasure, of surprise, of fear, of anger ; and this language consists of cries or tones, variously modulated, each species having its own range of vocal intonations. Every species understands the simple instinctive language of its own species. Some birds, for example, as the wild geese, have sentinels around the flock while feeding, and rise *en masse* at the warning cry of their guards. Who has not marked the distress and agitation of the ewe, when she hears the plaintive tremulous bleat of her lamb, forcibly separated from her ? The warning note of the cock, his cluck of invitation, his scream of surprise or fear, his cackle of agitation, his crow of defiance, are well understood by his train. Quadrupeds, birds, and even some insects call to each other, and are answered again—

"Steed answers steed with loud and boastful neighings."

The bird invites his mate by a sweet strain, and is answered by her low chirp. The call of the young in their nests is responded to by the parents; the parents call to each other, as if to assure themselves of each other's safety, or to find out where they mutually are, and what they are doing.

Imitation is an instinct; we see it powerful in its dominion over children; it is in exercise before reason assumes a definite sway; it prompts to the acquisition of the mother-tongue, till, by repetition, the true pronunciation is acquired, and the names of all common articles known: then reason steps in. But imitation is not confined to the human race; monkeys imitate, and the grotesqueness of their imitations renders them ludicrous; they do not imitate voice, but action. Some birds, however, imitate the human voice, and are easily taught to utter words or sentences, (the parrot, the mino-bird, the magpie, are examples,) nay, even to sing musical airs with great accuracy. But, by all this acquisition through the organ of hearing, they gain no information, nor add to the limited number of their ideas. The parrot may be, indeed, made by practice to associate the sound of a word, say bread, with the article thus denominated, and to call for it by name when wanted; but reason steps not in to give further assistance in the building up of idea upon idea, without which there can be no definite language—no real speech. Though the dog and the horse cannot utter the sound,

they know what bread is quite as well as the parrot, and, indeed, the ear of the dog is the inlet to an instinctive mind of no mean order, for the Almighty created the dog to be man's assistant and humble friend.

The question has been often mooted, as to whether song-birds acquire their respective warble or song by the ear alone, that is, by listening and imitating, as a child would do, or whether it is intuitive; the answer is not very easy. There is an impulse in song-birds to express their feelings of pleasure or enjoyment, by giving utterance to modulated sounds, so pleasing to the human ear, that their song leads too frequently to their friendly imprisonment. Young birds, brought up by their parents, and with a vocal pipe best fitted for the enunciation of the strain of their parents, (or rather male parent,) rapidly acquire that strain, and soon begin to record, or try it over in an under tone, and bearing it in memory, break out into full song when leafy spring returns. Nevertheless, birds, taken early from the nest, and put under the tuition of other birds, acquire to a certain extent the song of the latter, often, indeed, apparently perfect; yet, perhaps, could our ears catch it, we should find that the bird had much of the parent accent in its acquired language.

Though birds receive ideas of a simple character, and express simple feelings, understood by each other, through the medium of various sounds, yet nothing from age to age is thereby added to their knowledge; they re-

main what they have been from the commencement of their creation. Their ears are far less the inlets to knowledge than their eyes, and this observation applies generally to the lower animals.

Now let us turn to man. Setting aside meaningless sounds and noises, (some of which, however, through the association of ideas, are very grateful, as those of the multifarious denizens of a farm-yard,) man derives both pleasure and knowledge from a definite succession of sounds, which appeal to his mind, as sound cannot appeal to the mind of the lower orders. How laughable is the fabled contest of the lutist and the nightingale, and of the death of the latter disappointed of the victory—the lutist might have enjoyed the warbling of the bird, but the bird could not have entered as a rival into the strains of the lutist. Nevertheless, from personal observation, and from the most credible authorities, we fearlessly assert, that many animals are allured by sweet sounds; we have seen rats peeping out of their holes, listening to airs played on a flute; and sir Walter Scott says,

> "Rude Heiskar's seals through surges dark,
> Will long pursue the minstrel's bark."

A little lizard (the *anolis*) in the West Indies, and snakes in North Africa and India, are attracted by the notes of a rude pipe; to deny this is futile; it has been proved in modern days, and the fact is noticed in Scripture. Some animals, when certain notes are struck,

or certain keys tried over, are decidedly agitated, and perhaps feel as we do when some horrid sound "sets our teeth on edge,"—that is, irritates by a mysterious sympathy the whole nervous system. In the same way, perhaps, are animals pleased with certain sounds; that is, a sympathetic tranquillity or pleasing excitement of the nervous system is produced, and they yield, instinctively, to "the voice of the charmer."

With regard to ourselves, music (we need not enter into a learned explanation of what it is) operates far less upon the reasoning than the instinctive faculties of man. Tones, modulations, swellings, and cadences, though no words be sung, excite all the emotions of which our animal nature is capable. But when words are used—when music is married to immortal verse, and an appeal through language is also made to the mind, then, indeed, the effect is tremendous. A song shouted forth in the streets may overturn an empire. Who knows not what was the effect of the Jacobite songs in Scotland, when Charlie came "o'er the water?" Who knows not the effects resulting from *Caira* and the Marseillaise Hymn? Whose bosom has not beat high when our own national hymn, when Rule Britannia, and other patriotic airs, have been energetically and effectively delivered? In fine, who is there that is not affected by music? very few; it is and has been a natural expression of human feeling appealing to human feeling, since the time of Jubal even unto the

present day ; and Miriam's song of triumph, and the songs (how mournful !) of the daughters of Judah on the willowy banks of Babel's rivers, were equally expressive of natural emotions.

Music, then, without words, appeals rather to our animal feelings than to our reason or mind ; music, with suitable words, appeals both to our animal feelings and our mind; and music, with merely recollected words, does the same by concatenation of ideas ; and this also is often the result of tones, passages, and cadences, to which we have never heard words applied; hence, we talk of a lively air, a merry air, a martial air, a melancholy air ; and hence a great poet wrote—

> "That strain again ! it had a dying fall.
> Oh ! it came o'er my ear like the sweet south,
> That breathes upon a bank of violets,
> Stealing and giving odour."

Some airs, again, are solemn, and tend to fill the mind with awe, or a feeling of devotion ; deep strains of melody were those which resounded through the great temple, when the holy psalms of the shepherd-king were chanted, and deeply was every heart moved to the worship and adoration of the living God. Oh, such should ever be our sacred music ! Perhaps we are wrong, but we confess that the sweetest air composed for an ordinary song, (however pure, elegant, or patriotic that song may be,) when introduced into the house of God grates upon our feelings. We divide literature into profane and sacred (meaning nothing offensive by the term profane)—let, then, music

be as strictly divided, so that the association of ideas which a popular air will, in spite of ourselves, engender, shall not creep in to intertwine with the sacred exercise of praise and thanksgiving to our Creator and Redeemer, which alone should engage the full force of our mind.

The power of music in elevating the mind, in cheering it, or, on the contrary, in depressing it, has been felt from the earliest ages. When Saul was troubled in spirit, "David took an harp, and played with his hand: so Saul was refreshed, and was well, and the evil spirit departed from him." *

We have said, that animals appeal to each other through the organs of hearing by cries or sounds, nor is man destitute of natural cries, which are universally understood—the shout of exultation, the scream of terror, the shriek of agony, the moaning of mental or bodily suffering, and the sobs of sorrow, speak to every heart. But, besides these instinctive tones, man acquires a definite language, more or less extensive, more or less capable of expressing abstract or complex ideas, and ever in these points bearing progress with the advancement of the arts, with the civilization and with the religion of the people. There are some savage tribes who cannot count a hundred, but we can count to hundreds of millions, till the mind becomes overwhelmed with the vastness of the numerical progression, which, let each unit stand for a million of years, would, after all, infringe not on

* 1 Sam. xvi. 23.

eternity. Language is the appeal of definite sounds, through the organs of hearing, to the mind; these sounds are arbitrary; they do not in any way represent things, or the qualities, or the state of things; for, indeed, language is based altogether on a system of association—it has to be acquired; that is, the mind has to be taught to associate certain sounds with certain mental perceptions; but these sounds do not mean the same thing in every language or dialect. On this point we need not insist, neither need we give examples, which must suggest themselves to every reader, if he reflects that there are other tongues beside that which he speaks.

Though language consists in a system of sounds uttered by the mouth, appealing through the sense of hearing to the mind, yet man has contrived to effect the same purpose through the eye, and hence is enabled to convey to others at a distance his thoughts, his observations, his wishes, and views—to transmit to posterity the results of his labours and researches, or the outpourings of his genius. His plan is to employ certain marks or characters, drawn or impressed on paper, bark, wood, metal, or other materials, which characters shall be understood. These characters, which we call an alphabet, represent sounds; they are made up into words, and as our eye runs along them the varying sounds of the words are suggested, and with them the meaning; this is termed reading, and if we utter the words, reading aloud.

But there are other characters, not alphabetical, which have been, and still are, in use, and which are symbols of ideas, and not of sounds. "While the letters of our alphabet are mere symbols of sounds, the Chinese characters or written words are symbols of ideas, and alike intelligible to the people of Cochin-China, Japan, Loo-choo, and Corea, with those of China itself. As the best practical illustration of a written character, common to several nations who cannot understand each other's speech, Mr. Davis adduces the Arabic numerals, common to all Europe. An Englishman, who could not understand what an Italian meant if he said *venti-due*, could comprehend him immediately if he wrote down *twenty-two*. This advantage, which belongs to our numerals only, pertains to the whole language of the Chinese. The uniformity, however, in the written character, does not prevent the existence of great diversities in the oral languages of the neighbouring countries and China, and even of the separate provinces of the latter country. These diversities are precisely analogous to the different pronunciation given to the same numerical characters in the various countries of Europe.

"To adduce the foregoing example—the number 22, which the Italian calls *venti-due*, a Frenchman pronounces *vingt-deux*, and an Englishman *twenty-two*, though all three write them just alike. It is in this manner that the universality of the Chinese lan-

guage extends only to the written character, and that the natives of the two extremities of the empire, who read the same books, and understand each other perfectly on paper, are all but mutually unintelligible in speech. The roots, or original characters of the Chinese, are only two hundred and fourteen in number, and might, indeed, be reduced to a much smaller amount by a little dissection and analysis. These are combined with each other to form other words, or express other ideas, very much in the same way that the individual Arabic numerals are combined to express the infinite varieties of numbers. By a species of analogy, they may be called the alphabet of the language, with the difference that exists between an alphabet of ideas, and an alphabet of sounds."*

When the Chinese wish to write a European proper name, they have recourse to a contrivance which in some respects approaches the phonetic hieroglyphics of ancient Egypt. The Chinese characters when thus employed do not become alphabetic, but represent the entire syllable or sound which they express in ordinary use. Thus, if we suppose A, B, C, to stand respectively in the place of three Chinese characters, intended to give the name *Maria*, the mode would be thus—

A	*Ma*	Jasper
B	*Li*	Profit
C	*Ya*	Second in rank.*

* See Klaproth's Examen, etc., p. 25.

In ancient Egypt, two modes of writing were practised, namely, the *common* and the *hieroglyphic*. There were several kinds of *common* characters, and also, as it would appear, of *hieroglyphics*. Clemens of Alexandria distinguishes from both the *hieratic*, which was used by the sacred registrars. The ancient Mexicans employed pictorial writing; and of this nature we may consider the Bayeux tapestry, representing the chief incidents of the invasion of England by William I. Savages often give information to their friends, or convey their wishes, by cutting rude figures on the bark of trees, the meaning of which is at once understood by every individual of the tribe.

On these points we have sufficiently enlarged. Our main purpose is now to show how great an inlet to knowledge the ear is. To the eye speak the writings of antiquity, the accumulated wisdom of successive generations, the experience of sages, and those holy records which contain the oracles of God, the sacred truths, and the revelation of the purposes of the Almighty towards a fallen race. It is by language, as it appeals to the eye, that we commune with the mighty dead—that we receive into our minds the sublime ideas of a Milton, the learning of a Bacon, or the philosophy of a Newton. But it is to the ear that the conversation of ordinary life is directed; the directions, the requests, the commands that we continually issue forth or receive—words of congratulation, consolation, encouragement, or

information—the eloquence of the senate or the bar—the strenuous admonitions or exhortations of the preacher. What a wonderful thing the mind of man is, that a few atmospheric vibrations on the auditory nerves, or a few pictures on the retina, should produce sorrow or joy, hope or fear—should communicate instruction or pleasure—should excite sympathy or love, contempt or aversion! And, again, how wonderfully is the organic frame constructed, and adapted to the conditions of our planet, that light and air should communicate through two of our external senses with the mind, affording it food for cogitation, stores of knowledge, and intellectual gratification! Does this arise in any degree from the superiority of the organs of sight and hearing in man? Certainly not. The vulture, soaring in the upper sky, far excels man in the power of vision. Yes, and so does every bird that skims the air, or hovers in quest of prey over the surface of the great deep. The dog, the horse, the antelope, and numerous other lower animals, have quicker ears than man; but then the mind! it is there that the difference lies; with a weaker sight than is usual, with a more imperfect hearing than is ordinary, sages and philosophers, and historians and poets, have left to posterity the brightest productions of mental power. Homer and Milton were blind.

Through the sense of hearing man communicates orally with man, and man utters his

prayers and praises orally to God, as if God heard with ears like those of organic beings. It is natural that we should thus address ourselves to the Almighty, because our conceptions of him are necessarily limited by the measure of our minds, expansive as regards the lower creation, but narrow—oh, how narrow!—compared with the wisdom of the uncreate Eternal. "He that planted the ear, shall he not hear!"* It matters not whether we murmur forth with our lips, or silently think them in our mind—God hears them. He hears the language of our heart, the aspirations and vows of our inmost soul: and he knows, too, (and he alone can know,) whether we be sincere or the contrary. The tongue of the hypocrite may deceive men, but not God; nay, we may deceive ourselves by our own verbiage, but God distinguishes the prayer inspired by the Spirit of truth, from the empty declaration of excitement.

Thus, then, is the ear an inlet of a vast amount of knowledge to the mind; it conveys what the eye cannot convey, and it assists the eye, while in turn by the eye it is assisted; and, indeed, that one sense shall support another, and be again supported, or corrected, is ordained by our Creator, who in wisdom has fashioned our mortal framework, the tenement of an undying soul.

3. *Taste.*—The sense of taste conveys to the mind an impression from objects, very dissimilar to that which is gained through the

* Psa. xciv. 9.

medium of the eye or of the ear; nay, dissimilar to that conveyed by the sense of touch.

The sense of taste resides in the mouth; that is, it pervades the tongue, the palate, and the pharynx, on which are distributed fine ramifications of the fifth, eighth, and ninth pair of nerves.

Taste is the appreciation of the savour of bodies, or, in other words, of certain chemical qualities, which, acting on the nerves, give to our mind an agreeable or disagreeable sensation; hence the terms sweet, luscious, acid, vinous, sour, bitter, saline, spicy, aromatic, etc. Some bodies, however, are tasteless—pure distilled water is tasteless, and so would a small globe of glass be, however long it was held in the mouth; but if we put our tongue to a piece of brass, or copper, we perceive at once a peculiar flavour, resulting from the oxydized film on its surface mingling with the saliva covering the nervous papillæ of the tongue.

The organs of taste are placed at the commencement of the apparatus of nutrition, and their assigned work is to test the quality of the food received, thereby giving warning lest any noxious substance be introduced into the stomach. Man, indeed, employs the sense of taste far less decidedly in this manner than do most other animals; he is omnivorous; in the north he relishes train-oil and blubber, the blood of seals, and animal food half raw, while, in tropical regions, he feeds upon boiled rice or

other grain, seasoned with a little spice, and accounts it a luxury. In both cases, the taste is in consonance with the requirements of the system, placed under opposite circumstances. Man, however, acquires by habit an artificial taste, and comes at last to relish things which he at first disliked, and in many instances these things are more or less injurious. Nor is this artificial taste confined only to man—we have seen it in domestic animals—cats, by nature exclusively carnivorous, will eat boiled cabbage with relish; the dog will acquire a partiality for bread and biscuit. On the contrary, some of our herbivorous animals may be taught to like animal food. For example, in some parts of Arabia, flesh, raw as well as cooked, is occasionally given to the horses, with fragments of their owner's meals. An inhabitant of Hamah assured Burckhardt, that he had often given his horses roasted meat before the commencement of a fatiguing journey, that they might be the better able to endure it; this same person, as we learn from the learned traveller, fearing lest the governor should take from him his favourite horse, fed it for a fortnight exclusively upon roasted pork, which so excited its spirit and mettle, that it became absolutely unmanageable, and no longer an object of desire to the governor.

In the Edinburgh Journal of Natural History we find the following passage: "We are assured by M. Yvart, that in Auvergne fat soups are given to cattle, especially when sick

or enfeebled, for the purpose of invigorating them. The same practice is observed in some parts of North America, where the country people mix, in winter, fat broth with the vegetables given to their cattle, in order to render them more capable of resisting the severity of the weather. These broths have been long considered efficacious by the veterinary practitioners of our own country, in restoring horses which have been enfeebled through long illness. It is said by Peall to be a common practice in some parts of India to mix animal substances with the grain given to feeble horses, and to boil the mixture into a sort of paste, which soon brings them into good condition, and restores their vigour. Pallas tells us, that the Russian boors make use of the dried flesh of the hamster, reduced to powder, and mixed with oats, and that this occasions their horses to acquire a sudden and extraordinary degree of *embonpoint*. Anderson relates, in his History of Iceland, that the inhabitants feed their horses with dried fishes when the cold is very intense, and that these animals are extremely vigorous, though small. We also know, that in the Feroë Islands, the Orkneys, the Western Islands, and in Norway, where the climate is still very cold, this practice is also adopted; and it is not uncommon, in some very warm countries, as in the kingdom of Muskat, in Arabia Felix, near the Straits of Ormuz, one of the most fertile parts of Arabia; fish and other animal substances are there given to the

horses in the cold season, as well as in times of scarcity."

In Norway, or at least in some districts of that country, the cattle are housed during the long winter months, and fed partially upon hay, but more plentifully on a kind of diet, which, strange and disgusting as we may think it, is said to be much relished. This consists of a thick gelatinous soup, made by boiling the heads of fish, and mixing horse-dung with the broth; so that the boat of a Norwegian farmer supplies not only himself and his family with the staple portion of winter subsistence, but his cows also.

We doubt much whether any wild herbivorous animals will feed upon poisonous plants; they are constantly in the exercise of their instinctive faculties, and to these faculties the organs of taste (and smell) administer. Hence they constantly reject all that is deleterious. But this is not the case with domestic animals, whose instinct is much enfeebled, or curbed, from the peculiar circumstances in which they are placed. Hence accidents often happen, to the great loss of the farmer; for example, both horses and horned cattle will crop the foliage of the yew, which offers a temptation to them, especially if underfed, or fed almost exclusively on dry fodder; the foliage of the yew is poisonous. Cattle often perish from eating the long-leaved water hemlock, or cowbane, (*Cicuta virosa.*) "When Linnæus visited Tornea, he found a terrible malady sweeping away the

cattle of the district, and which he at once traced to the long-leaved water hemlock. Scarcely, in fact, had he crossed the river, and landed from his boat on the meadow, before he felt convinced of the origin of the mischief. This deadly plant grew there in abundance, and it appeared that as soon as the cattle left off their winter fodder, and returned to pasturage, they died swollen and convulsed; as the summer came on the mortality decreased, and still more so with the advance of autumn.

"The least attention," says Linnæus, "will convince us that brutes reject whatever is hurtful to them, and distinguish poisonous from salutary plants by natural instinct, so that this plant is not eaten by them in the summer and autumn, which is the reason that in those seasons so few cattle die; namely, such only as either by accident or pressed by extreme hunger eat of it. But when they are let into the pastures in spring, partly from their greediness after fresh herbs, and partly from the emptiness and hunger they have undergone during a long winter, they devour every green thing which comes in their way. It happens, moreover, that herbs at this time are small, and scarcely supply food in sufficient quantity. They are, besides, more juicy, and covered with water, and smell less strong, so that what is noxious is not easily discerned from what is wholesome. I observed, likewise, that the radical leaves were

always bitter, the other not, which confirms what I have just said. I saw this plant in an adjoining meadow, mowed along with grass for winter fodder; and, therefore, it is not wonderful that some cattle, though but a few, should die of it in winter. After I left Tornea, I saw no more of this plant till I came to the vast meadows near Limmingen, where it appeared along the road, and when I got into the town I heard the same complaints as at Tornea, of the annual loss of cattle, with the same circumstances." Monkshood, meadow-sweet, hemlock, (*Conium maculatum*,) meadow-saffron, foxglove, etc., are occasionally eaten by cows, and prove fatal.

The sense of taste varies greatly in different animals; in granivorous birds, in reptiles and fishes generally, we cannot suppose that the impressions made on the gustatory nerves are at all delicate; they swallow their food entire at a single gulp, and their tongue is covered with a thick or a horny cuticle. Among birds, the carnivorous tribes, the parrots, and the swans, and true ducks, possess the sense of taste in considerable perfection. Among reptiles, tortoises and vegetable-feeding lizards, as the iguana, are, as it would seem, superior to the others; and among fishes, it is probable that those which feed on marine or aquatic vegetables, are endowed with a higher degree of taste than those which prey upon other fishes, which they engulph at once. It cannot be denied that many insects, as bees, wasps,

butterflies, the house-fly, and various others, enjoy a keen sense of taste, and relish the sweets which prove so attractive to them.

Among the mollusca, some, at least, are endowed with the sense of taste in no low degree; the snail and the slug are examples in point, as the gardener can readily testify.

What information do we gain by the sense of taste? The eye and the ear conduce to our mental improvement, to our store of knowledge, to our appreciation of the sublime and beautiful. Eloquence, music, poetry, painting, sculpture, architecture, scenery—the glory of the sun, and the moon, and the stars—these appeal to our mind through the organs of sight and hearing; but the sense of taste administers rather to our animal than to our intellectual being, and, doubtless, the pleasures of taste contribute greatly to the enjoyments of our existence. Taste, then, belongs to us less as spiritual, intellectual, immortal beings, than as corporeal, mortal beings; nevertheless, it is part of our nature, implanted in us by an all-wise God, in order that we should relish the provisions for sustaining life, which he has so bountifully provided. To pretend that we are indifferent to the pleasure or the disgust resulting from taste is an untruth—nay, it is to say that God's gifts to us are not worth our consideration. Our Lord and Saviour was one of a party at a marriage feast, and when the wine was exhausted, he turned water into wine,

which was superior to that previously passed round. "This beginning of miracles did Jesus in Cana of Galilee, and manifested forth his glory."* But while, with a healthy appetite we relish our food, giving thanks to God for his bounty, let us not be epicures or gluttons; let our moderation be seen; let us use, not abuse, the gifts of our heavenly Father.

4. *Smell.*—On a fine, filmy membrane, which lines the labyrinth of the nasal cavities, are distributed the delicate ramifications of the olfactory nerves, or the nerves of smell. These nerves are constructed for transmitting to the mind impressions arising from the floating exhalations of odoriferous substances. It is through these nasal cavities, principally, that man and quadrupeds breathe; hence the respiration of the air informs us of our proximity to objects disgusting and noxious, or, on the contrary, attractive from their fragrance. Surely we need not adduce instances in proof of our position. The scent of putrescent animal or vegetable matters is in itself a warning to us to retire from the locality of mortific corruption, and escape from the region of disease. How loathsome to our sense are these putrescent effluvia! They nauseate us even to sickness—nay, sometimes almost to fainting; indeed, the writer has seen a violent fit of epilepsy produced by the overpowering and horribly disgusting odour of the matter contained in the scent pouch of a small quad-

* John ii. 11.

ruped, the grison, (*Galictis vittata*,) which he was dissecting, the sufferer being a practical zoologist, accustomed to the dissecting-room.

But when the voice of the nightingale is heard, and the air is loaded with the perfume of the hawthorn blossom, and of thousands of spring flowers, are we not invited, as it were by a secret call, to walk abroad through woodlands and meadows, contemplating the works of God? We are thus lured to beneficial exercise—to inhale

"The breezy fragrance of the morn"—

to forget the trials of life, and muse upon a still brighter world, where the flowers perish not, where storms come not, and where winter is unknown. Thus, to our bodily health do our senses administer; and thus the sense of smell calls us from the close room of the populous city, into the fresh air of the country —from the crowded town,

"Where houses thick and sewers annoy the air,"

to issue forth on a summer's morn, and breathe the pure air redolent of sweetest odours.

When overpoweringly offensive effluvia disgust us, we endeavour to stop our breath—we breathe at protracted intervals, take in as little air as possible, and endeavour to escape from the infected locality; but do we flee away from the gale bearing the scent of the honeysuckle, the bean-field, or the new-mown hay? It is, indeed, rather to our pleasures, to our mental enjoyment, to our delight, or to our disgust and abhorrence, that our sense of smell

administers. We depend little upon it for our discrimination between things acting as poison, and things nutritious or wholesome. How pleasant is the smell of laurel-water or prussic acid—how dull and insipid the smell of wheaten flour! We must not, then, always be guided by our sense of smell, although in general it serves us as a monitor.

The sense of smell is intimately combined with that of taste; indeed, it is a powerful auxiliary to it, for, as a learned writer well observes, "taste, without the aid of smell, would be very vague in its indications, and limited in its range." Nevertheless, savage people, in whom the sense of smell is far more acute than in civilized races, do not appear to possess a greater refinement of taste—indeed, what the former regard as delicacies would be rejected by the latter with abhorrence. Most quadrupeds possess the sense of smell in far greater perfection than man, and are evidently influenced by it in their choice or rejection of food. In the carnivorous tribes this sense is, perhaps, at its highest ratio, and many pursue their prey guided by their olfactory organs alone.

Certain odours are agreeable to some few animals, irrespective of food; but on this point our range of information is limited. The cat delights in the scent of valerian, and some other herbs, although they are not among the articles of this animal's diet; yet to the cat and the dog, the odour of the sweetest flowers yields no pleasure. Birds, in general, are endowed with

the sense of smell in a far lower degree than quadrupeds, and the olfactory organs are far less developed. Birds of prey are guided by their keen powers of vision, and, indeed, if we are to trust to the experiments of Audubon, the sense of smell even in the carrion-loving vulture, contrary to the opinion of the ancients, as well as of modern naturalists, is at a low ratio; for, as he asserts, the stuffed skin of an animal will attract a vulture from its "pride of place," in the upper regions of the air. It is true that this assertion has been contradicted by Mr. Waterton, but it is again confirmed by the experiments and observations of Mr. Bachman, which are recorded in Loudon's Magazine of Natural History, viii. 167; and M. Levuillant seems to have considered that it is by the eye chiefly, if not exclusively, that the vulture obtains its disgusting food. The following observations from the proceedings of the Zoological Society will be here, perhaps, not unacceptable:—

March 14th, 1837.—"A paper was read on the habits of the *Vultur Aura*, by Mr. W. Sells, with notes of the dissections of the heads of two specimens, by Mr. R. Owen. The writer states, that this bird is found in great abundance in the island of Jamaica, where it is known by the name of *John Crow;* and so valuable are its services in the removal of carrion and animal filth, that the legislature have imposed a fine of £5 upon any one destroying it within a stated distance of the principal towns.

Its ordinary food is carrion, but when pressed hard with hunger, it will seize upon young fowls, rats, and snakes. After noticing the highly offensive odour emitted from the eggs of this bird when broken, Mr. Sells relates the following instances which have come under his own personal observation, for the purpose of proving that the *Vultur Aura* possesses the sense of smell in a very acute degree.

"It has been questioned whether the vulture discovers its food by means of the organ of smell or that of sight. I apprehend that its powers of vision are very considerable, and of most important use; but that it is principally from highly organized olfactories that it so speedily receives intelligence of where the savoury morsel is to be found, will plainly appear by the following facts. In hot climates, the burial of the dead commonly takes place in about twenty-four hours after death, and that necessarily, so rapidly does decomposition take place. On one occasion, I had to make a *post mortem* examination of a body within twenty hours after death, in a mill-house completely concealed, and while so engaged the roof of the mill-house was thickly studded with these birds. Another instance was that of an old patient and much valued friend, who died at midnight; the family had to send for necessaries for the funeral to Spanish Town, distant thirty miles, so that the interment could not take place until noon of the second day, or thirty-six hours after his decease, long before which time—and a most

painful sight it was—the ridge of the shingled roof of his house, a large mansion of but one floor, had a number of these melancholy heralds of death perched thereon, beside many more which had settled in trees in its immediate vicinity. In these cases, the birds must have been directed by smell alone, as sight was totally out of the question.

"In opposition to the above opinion, it has been stated by Mr. Audubon, that vultures and other birds of prey possess the sense of smell in a very inferior degree to carnivorous quadrupeds, and that, so far from guiding them to their prey from a distance, it affords them no indication of its presence even when at hand. In confirmation of this opinion, he relates, that he stuffed the skin of a deer full of hay, and placed it in a field; in a few minutes a vulture lighted near it, and directly proceeded to attack it, but finding no eatable food, he at length quitted it. And he further relates, that a dead dog was concealed in a narrow ravine, twenty feet below the surface of the earth around it, and filled with briers and high canes; that many vultures were seen sailing over the spot, but none discovered it. I may remark upon the above experiments, that, in the first case, the stag was doubtless *seen* by the birds, but it does not follow that they might not also have smelt the hide, although inodorous to the human nose; in the second case, the birds had been undoubtedly attracted by the *smell*, however embarrassed they might have been by the concealment of

the object which caused it. I have, in many hundred instances, seen the vulture feeding upon small objects under rocks, bushes, and in other situations, where it was utterly impossible that the bird could have discovered them but through the sense of smell; and we are to recollect, that the habit of the vulture is that of soaring aloft in the air, and not that of foraging upon the ground."

To this account are appended the details of a minute comparison, by professor Owen, of the olfactory nerves and the olfactory branch of the fifth pair in the *Vultur Aura*, with those of the common turkey and the goose. The learned anatomist concludes by saying, "the above notes show that the vulture has a well-developed organ of smell, but whether he finds his prey by that sense alone, or in what degree it assists, anatomy is not so well calculated to explain as experiment."

It is far from being impossible that Mr. Waterton and Mr. Wells on one side, and Mr. Audubon and his party on the other, may be both correct, for in different species of vulture the power of smell may greatly differ; we know that it does among carnivorous quadrupeds, which seek their prey, some chiefly by sight, others by their acuteness of scent. Among reptiles, the sense of smell appears to be at a low ratio, nor can we suppose that it is acute in fishes. In fact, in fishes the nasal cavities are rudimental, and do not communicate with the organs of respiration. They are

nothing more than blind sacs, placed one on each side in front of the head, with two external openings appertaining to each sac. The principal entrance is valvular, and on a curiously plaited membrane in the sac itself, or on tufted or arborescent filaments, are the ramifications of the olfactory nerves distributed. That fishes are attracted or repelled by the odorous effluvia of bodies, diffused either through the water itself or through the air which the water contains, is too well ascertained to be denied. Fishes, in fact, are attracted by certain odoriferous substances, and anglers often use baits impregnated with some volatile oil.*

We cannot for a moment doubt that insects smell; that ants and bees are greatly directed by this sense in their search after food; that carrion-loving beetles are thereby guided from a distance to their repast; that the flesh-fly is led to putrescent animal substances; and we know that the flesh-fly is sometimes deceived by the smell of certain plants emitting a cadaverous odour, and deposits her eggs upon them, the larvæ perishing for want of proper food. In what organ the senses of smell in insects are placed does not appear very plain, and the like observation applies to the *crustacea*, as crabs and lobsters, for which baited traps are set, and into which they are allured by their sense of smell.

No distinct organs of smell have been discovered in the mollusca, yet it is incontestable

* On this subject see Izaak Walton's "Complete Angler."

that some of these creatures are capable of appreciating odours. We cannot suppose that in the highly-organized and savage cuttle-fish this sense is wanting; and we know that snails and slugs are attracted from a distance by the odour of the favourite plants or fruits on which they feed. The garden slugs are fond of animal food, as we can testify, and they will pick bones with relish; we have seen the hollow of a marrow-bone thrown into the garden filled the next morning with slugs, which had completely cleaned it.

Whether the bivalve mollusks, as mussels, oysters, clams, etc., have any definite sense of smell, we cannot ascertain, but we conjecture that they are endowed with the sense of taste, for they know what to accept and what to refuse.

We have said that man derives pleasure or disgust from the exercise of the sense of smell, and is greatly directed thereby what to choose and what to avoid; yet this sense harmonizes with those of sight, hearing, and more particularly of taste, to render this world delightful to us, if we use God's gifts aright. Has he not scattered the loveliest flowers in garden and meadow? Has he not created fruits that gratify alike the sight, the touch, the taste, and the smell? Has he not spread the beauties of nature around us? Was not the garden of Eden prepared for our first parents? Yes; but sin has entered the world, and over flower and fruit has been the "trail of the serpent."

A few passages from the Scriptures, on which

we need not comment, will serve to show the figurative notice of, or reference to this sense by the sacred writers, in order to influence the mind of man through an appeal to his own sensations. "An odour of a sweet smell, a sacrifice acceptable, well-pleasing to God," Phil. iv. 18. Works pleasing to the Lord, deeds of charity and mercy, done by the believer as a testimony of his lively faith, and a proof to the world that faith engenders good works; such works, and not those of the pharisee, are an odour acceptable to God. "Walk in love, as Christ also hath loved us, and hath given himself for us an offering and a sacrifice to God for a sweet-smelling savour," Eph. v. 2. Let us, who call ourselves Christians, so walk, that our conduct before men may be after the pattern of Him, who, in love to a fallen race, offered himself as a sacrifice fragrant unto God the Father, that we might escape the sword of justice. When Noah offered burnt-offerings on the altar, "the Lord smelled a sweet savour," Gen. viii. 21; and to Him even now, O reader, will be fragrant true penitence and faith in that Mediator, of whom the sacrifices under the primitive dispensation were but types, and in this sense only did they waft incense to the throne of the Almighty! The language is altogether figurative; but how pertinent to our feelings, and therefore how clear to our understanding, and how forcible!

5. *Touch.*—Of all the senses, not one is so

important to us as that of tact or touch. It is the foundation, as it were, of all our knowledge of the material world, and according to their elevation in the scale of being do animals enjoy this sense in greater perfection, and possess organs in which it is more especially concentrated. We here distinguish between mere feeling and touch. We consider the wings of the bat, and the antennæ of insects, rather as feelers than as organs of exact appreciation. The sense of feeling is diffused over the whole surface of our body; but the sense of touch, so far as man is concerned, resides in the hand, and especially in the pulpy tips of the fingers.

It is true that we use the word feel when we test the qualities of bodies with our hands, and in this sense our hands are feelers. But we derive a knowledge from the use of our hands, which no other animal derives from the exercise of any organ of tact it may possess. Nor is this to be wondered at, for in all other animals tact or touch administers only to their physical necessities. For example, the sense of touch in the pulpy end of the beak of the snipe or woodcock must be exquisite—multitudinous are the nerves supplying that part—for even the soft worm or larva in the oozy ground is felt, and the finger of man would most probably fail here; but in man the sense of touch appeals to the mind, and communicates mental pleasure, mental instruction, or even mental disquietude. Even as discords in music, or grating sounds,

such as the filing of a saw, or the rubbing of cork against a wall, excite the nervous system through the mind, so does the sense of touch disturb the mind and body when that which is touched is discordant. A lady of the writer's acquaintance, by no means timid, and by no means afraid of snakes, was induced to let a common snake glide through her hand; she bore the sensation with firmness, but she nearly fainted when the snake had crept through her grasp, and described the working of the reptile's ribs and abdominal plates as communicating an indescribable sensation. Yet that snake was a sort of pet, and she used to stroke its head, and feel its lambent tongue quiver against her hand. She was not afraid, but the sensation jarred like discordant notes.

Were persons to write down their experiences of the pleasing and unpleasing sensations derived through the medium of the different senses, and were those notes collected together, we should have a mass of most interesting and instructive information, well worthy the study of a physiologist. After all, however, the sense of touch or tact gives less pleasure to man than that of sight, hearing, taste, or smell; it appreciates neither colours nor harmony, nor the flavour of luscious viands, nor the odour of flowers and perfumes; but it communicates greatly to his store of information. It is a "matter of fact" sense, and though an old poet has said—

> "Have you felt the wool of the beaver,
> Or swan's down, ever?"

it is not one of the senses which figure on the page of poetry or romance.

We discriminate, then, between the sense of touch and that of mere feeling. Most probably all animals, even the lowest mollusks, feel, —nay, even animals in which no nerves are to be discovered, as the acalephæ, or jelly fishes; but touch is a refinement upon feeling, which is restricted within certain zoological bounds. A learned writer says: "The conditions on which the perfection of the sense of touch depends are, first, an abundant provision of soft papillæ, supplied with numerous nerves; secondly, a certain degree of fineness in the cuticle; thirdly, a soft cushion of a cellular substance beneath the skin; fourthly, a hard resisting basis, such as that which is provided in the nails of the human fingers; and lastly, it is requisite that the organ be so constructed as to be capable of being readily applied, in a variety of directions, to the unequal surfaces of bodies, for the closer the contact, the more accurate will be the perceptions conveyed. In forming an estimate of the degree of perfection in which the sense is exercised in any particular animal, we must accordingly take into account the mobility, the capability of flexion, and the figure of the parts employed as organs of touch."*

This is decidedly true as regards the higher orders of creation; but let us look at insects—do not bees, and wasps, and flies feel? can we

* Dr. Roget.

watch a fly brushing its head and wings, and rubbing its little paws against each other, without an assurance that it enjoys the sense of touch? and what shall we say of the spider, that feels at each thread, and "lives along its line?" Surely its sense of touch must be sufficiently acute; yet it is limited to a certain given object, and the spider gains only that information which bears upon its animal necessities. But the sense of touch gives to man a number of the properties of matter, which he retains as abstract ideas, such as dimension, form, condition of surface, hardness, softness, elasticity, compressibility, fluidity, quiescence, motion. In many and most important respects it assists the eye; and, indeed, the senses of sight and of touch appear to be correctors and supporters of each other. As in the case of every other sense, accuracy is greatly improved by habit, yet the qualities of matter, under the dominion of touch, are ascertained in so correct a manner that we are scarcely ever deceived by the knowledge thus acquired.

Dr. Fleming, in his "Philosophy of Zoology," thus writes: "The sense of touch appears in man to be able to obtain nearly all the information, with regard to external objects, which it is capable of receiving. In a few instances, the lower animals surpass us in the delicacy of the sense, as the bat, which is warned indirectly by its aid of the presence of bodies previous to coming in contact with them. The feelers of insects are likewise better

adapted for exploring the condition of the surface of bodies than any organ which we possess. But in all these the sensibility of touch is limited to particular qualities, or confined within narrow bounds. The human hand, on the contrary, by its motions, the pliability and strength of the fingers, and their softness, is the most extensive and perfect organ of touch possessed by any animal."

The accuracy of the sense of touch is greatly improved by habit; and when its resources are in constant demand, as in the instance of persons deprived of sight, or born blind, its discriminating powers are wonderfully increased. The same observation applies also to the sense of hearing, which in blind persons generally is extremely acute and accurate in its perceptions. In a Monthly Volume, published by the Religious Tract Society, and entitled "Comparisons of Structure in Animals: the Hand and the Arm," the reader will find a general account of the structure and uses of the anterior limbs of man and the lower animals, and of the substitutes for the hand, as an organ of touch and prehension, with which many of the latter are provided.

Dr. Fleming regards the "sense of heat" as distinct from that of touch, and, in fact, as claiming to be one of the senses. "The sense of touch," he writes, "is exclusively occupied with examinations of the conditions of resistance. Contact, therefore, is indispensably requisite for enabling the organ to act upon the

object, and muscular exertion to examine its condition. Neither of these is necessary to enable the sense of heat to act. Caloric rays emanate from a heated body, though at a distance; and in order to ascertain their direction and intensity no muscular effort is required. When the heated body happens to be in contact with us, we in like manner examine its conditions in reference to temperature without any muscular exertions, or, rather, we try to avoid them. Thus, when I lay my hand upon the table to examine its hardness or smoothness, I make an obvious muscular effort with my fingers; but when I lay my hand upon the table to examine its temperature, I endeavour to check all motion, so as to keep my hand in the same position. These qualities of the sense of heat sufficiently distinguish it from that of touch, with which it has been confounded, and justify its establishment as a distinct power of perception."

It is true that we cannot test caloric by the touch, but it does not appear to us that an appreciation of caloric involves any other sense than that of ordinary cutaneous feeling; the feeling of heat or cold is a mere sensation, agreeable or painful as circumstances may be, and it is natural that we should wish to experience that temperature which is most congenial to us. We say that marble is cold and wood warm, yet both may be of the same temperature; but the marble produces a sensation of coolness, because it rapidly abstracts caloric from the part

applied to it; the skin is, in fact, a very imperfect thermometer, yet sufficient for all ordinary purposes. It conceals the machinery of our bodies, giving beauty of outline and appearance, and being provided with a most minute network of nerves of sensation, it gives us warning by the pain experienced of what things are to be avoided. "A burned child dreads the fire" is an old saying, and a boy who has been stung by a nettle will not rashly meddle with the plant again.

All our senses require training and education; they are taught, even as we are taught language. It is some time before the infant sees distinctly, or forms any idea of size, proportion, or distance; long before it hears accurately, and understands a word of speech; longer still before it discriminates between musical notes; it is long before delicious odours are relished, and long before there is much distinction of flavour in food, for instinct directs the infant to its mother's breast, and for many a year sweet viands are chiefly acceptable. Habit, exercise, practice, then improve the power and acuteness of the senses, but simple feeling is blunted by habit and exercise.

It is, we think, Mr. Lane who tells us, that in Egypt and elsewhere, persons who have hoarded wealth are in the habit of inflicting the bastinado on themselves, increasing the number of strokes by degrees, in order to inure themselves to a mode of extortion of which they are constantly in dread. They hope to be able to

weary out their tormentors, or convince them by endurance of their poverty, and so preserve their bags of gold and silver. Idolatrous devotees in India accustom themselves to self-inflicted torture, and feel much less than we might suppose; nay, even in our own country, in times of spiritual darkness, when by mortification and penance men hoped to merit heaven, how many have worn a shirt of horsehair till custom had made it no hardship! The ancient Britons bore, almost unclothed, the severities of winter; and we have read a story, but where we cannot recollect, to the following purport:— A North American Indian was asked, how, nearly naked as he was, he bore with such ease the summer's heat and the winter's cold; he asked the inquirer, how his face, exposed to the weather, endured the changes. My face, said the white man, is hardened to it; and I, retorted the red man, am face all over.

We have said it is long before an infant is in the full use of its bodily senses: now with regard to feeling the infant is acutely sensitive; but who ever saw a child of a few months old examine the qualities of objects by the touch? it cannot even manipulate; it cannot use its hands; it has to learn the art of touch, and to improve by practice and the exercise of the mind. For example, some persons will pass a piece of silk or cloth between their fingers, and tell you its quality; and so with respect to other things; this is the result of attention and exercise.

No one is born without the organization necessary for the development of the sense of touch, for if the arms and hands be deficient, some other part, as the lips or tongue, will take up the function, and this alone shows what education effects; but if a person be born deaf, or blind, or incapable of taste and smell, (which latter appears to be very rare, if, indeed, the case ever occur,) no other part can supply the loss; but the loss, as far as the sight at least is concerned, is partly compensated for by the elevation of the sense of touch; and in this we see the immediate bearing of these two senses on each other.

The boy born blind, upon whom Cheselden so successfully operated, believed, when first he saw, that the objects touched his eyes, as the things which he felt touched his skin; consequently he had no idea of distance. "He did not know the form of any object, nor could he distinguish one object from another, however different their figure or size might be; when objects were shown to him which he had known formerly by the touch, he looked at them with attention, and observed them carefully, in order to know them again; but as he had too many objects to retain at once, he forgot the greater part of them, and when he first learned, as he said, to see and to know objects, he forgot a thousand for one that he recollected. It was two months before he discovered that pictures represented solid bodies; until that time he had considered them as planes and surfaces differ-

ently coloured, and diversified by a variety of shades; but when he began to conceive that these pictures represented solid bodies, in touching the canvass of a picture with his hand he expected to find something in reality solid upon it, and he was much astonished when, on touching those parts which seemed round and unequal, he found them flat and smooth like the rest. He asked which was the sense that deceived him—the sight or the touch. There was shown to him a little portrait of his father, which was in the case of his mother's watch; he said that he knew very well that it was the resemblance of his father, but he asked with great astonishment how it was possible for so large a visage to be kept in so small a space, as that appeared to him as impossible as that a bushel could be contained in a pint." *

In the Philosophical Transactions of 1826 will be found the account of a case by Mr. Wardrop, which is very interesting; it is that of an intelligent female of mature age, who was born blind; in her infancy, operations were performed on both of her eyes, but they failed, one eye being irrecoverably destroyed, and the other useless from closure of the pupil; on this eye Mr. Wardrop successfully operated: but it was not with joy that objects for the first time were perceived; she was confused by the appearance of a new world, now for the first time opened to her sense of sight; hitherto she had known it only through the sense of touch, and touch and

* Phil. Trans., 1728.

sight had still to be reconciled. "On the sixth day, she said that she saw better than she had done on any preceding day, but I cannot tell (said she) what I do see; I am quite stupid. She seemed, indeed, bewildered from not being able to combine the knowledge acquired by the senses of sight and touch, and felt disappointed in not having the power of distinguishing at once by her eye, objects which she could so readily distinguish from one another by feeling them.

"The next day, on examining with the eye the tea-cups and saucers, and being asked what they were—I don't know, she replied; they look very queer to me, but I can tell in a minute when I touch them. So with an orange which was lying before her, she could make nothing of it until she actually touched it. When the experiment was made of giving her a silver pencil-case and a large key to examine with her hands, she discriminated and knew each distinctly; but when they were placed on the table side by side, though she distinguished each with her eye, yet she could not tell which was the pencil-case and which the key.

"In six weeks after the operation, she returned home. At this period, she had learned a great deal; she had acquired a pretty accurate notion of colours, but with regard to forms and distance she was still very ignorant. She had also great difficulty in directing her eye to an object, so that when she attempted to look at anything she turned her head in various

directions, until her eye caught the object of which it was in search. She still entertained, however, the same hope, which she expressed soon after the operation, that when she got home, her knowledge of external things would be more accurate and intelligible, and that when she came to look at those objects which had been so long familiar to her touch, the confusion which the multiplicity of external objects now caused would in a great measure subside."

Thus, then, it is from an association between the senses that correctness and precision in any one sense are acquired; and especially do the eye and hand support each other, and supply each other's deficiencies till both have learned their perfect lesson. I can stretch my hand out to any object before me with certainty, so truly does the eye tell me whether it is within my reach or not, but the eye first learned that faculty from the hand, after long discipline and many trials. Afterwards the eye speaks a silent language to the hand, and is understood. Under what merciful circumstances are they placed that possess all their faculties and senses! but, alas! how many are there that never dream of thanking a merciful God for his unbounded kindness! nay, there are some atheistical materialists who believe, or rather pretend to believe, that man's exquisite organization, and that of animals and plants, is self-developed—how, they do not condescend to explain; for, granting them their premises, namely, that matter is eternal—and what then?

it must be inert, and neither the laws of vitality nor chemistry, involving electricity and galvanism, could be taken on by inert particles—all would be chaotic, did not God govern, arrange, and order all. It is he who has created man, and, fallen as man is, he still is an object of God's care; for he sent his well-beloved Son into the world for our redemption, and the time is coming in which all nations shall know the Lord, and adore him in sincerity and truth.

Like all the organs of our senses, the hands are the instrument of wickedness to sinful man; his sense of touch is the inlet of evil. How refined that sense in the adroit pickpocket, but to what an ill purpose is it devoted! How dexterous are the hands of the shoplifter, but to what a wretched course have they been trained! The hand grasps the pen; every stroke is guided by its delicate sense of touch; it obeys the mind; and, oh! what dictations from the depraved mind have polluted society! God has been reviled, Jesus Christ denied, the Holy Spirit mocked, and in letters written by hands which the almighty Maker and Preserver had endowed so supereminently. Their hands are mouldering; dust has returned to dust; but where are the immortal spirits which directed those hands to scatter poison abroad? It is not for us to inquire or judge. Let us, ourselves, be watchful, and let our hands be clean in the sight of God; let us be diligent in business, serving the Lord; let us fight the good fight of faith, and lay hold on eternal life!

Though we have described the hand as the great and main organ of touch, let it be understood that it is not the first called into operation. The hand requires rigid discipline; for a long period it is useless as an organ of tact; yet, when educated, how perfect, how precise! But it is made what it is by education. Our ideas coincide exactly with those of sir Charles Bell, who thus writes: "The lips and the tongue are first exercised; the next motion is to put the hand to the mouth in order to suck it; and no sooner are the fingers capable of grasping, than whatever they hold is carried to the mouth; so that the sensibility to touch in the lips and tongue, and their motions, are the first inlets to knowledge, and the use of the hand is a later acquirement."

Another passage from the same gifted writer is as follows: "The first office of the hand, then, is to exercise the sensibility of the mouth; and the infant as certainly questions the reality of things by that test, as the dog does by its acute sense of smelling. In the infant, the sense of the lips and tongue is resigned only in favour of the sense of vision, when that sense has improved, and offers a greater gratification, and a better means of judging of the qualities of bodies. The hand very slowly acquires the sense of touch; and many ineffectual efforts are seen in the arms and fingers of the child, before the direction of objects or their distance is ascertained. Gradually the length of the arm, and the extent of

its motions, become the measure of distance, of form, of relation, and perhaps of time."

Throughout life, the sensibility, as it regards tact, of the tongue and lips continues paramount; we can feel the slenderest hair with our tongue, which our hands would not appreciate: but, on the contrary, size, form, distance, order, and the general qualities of matter, can only be gained through the hand, after a persevering discipline. A blind man may examine a statue with his hands, and pronounce upon its excellence; and this fact suggests to us an idea of sir Charles Bell, who says: "The knowledge of external bodies, as distinguished from ourselves, cannot be acquired until the organs of touch in the hand have become familiar with our own limbs. We cannot be supposed capable of exploring anything by the motion of the hand, or of judging of the form or tangible qualities of an object pressed against the skin, before we have a knowledge of our own body as distinguished from things external to us." From these remarks we naturally slide into a dissertation on a sense, allied to that of touch, but yet different—we mean muscular sense.

6. *Muscular sense.*—God in his infinite wisdom has constructed all living things, and no doubt there is much yet for the philosopher to discover in the organization of animal bodies; there is, moreover, something that he never will understand, namely, life intrinsically considered, and the manner in which the immortal

spirit and the dying body communicate with and influence each other. But though these points must ever remain a mystery, still there are those the obscurity of which science has to a certain degree dispelled, and it was reserved for a late scientific anatomist to prove to the world, that the nerves of sensation and the nerves of motion are essentially distinct, although interblended together they pervade every muscle. Hence, as this philosopher observes, (we mean sir Charles Bell,) we are sensible of the action of our muscles, because these muscles have two classes of nerves ; and he found that in exciting one of these the muscle contracted, while on exciting the other no action took place. The nerve which had no power to make the muscle contract was the nerve of sensation.

Continuing his experiments, he proved that there is a nervous circle connecting the muscles with the brain, that one nerve is not capable of transmitting what is called the nervous spirits in two different directions at one instant of time, but that for the regulation of muscular action there is a nerve of sensibility, to convey a sensation of the condition of the muscles to the sensorium, as well as a nerve of motion for conveying the mandate of the will to the muscles. He also demonstrated, that in their distribution through the body, the nerves which possess these two distinct powers of conveying sensation, and of exciting the muscles to contraction, are wrapped up, or, as it were, woven together in the same sheath, and that they present to the

eye the simple appearance of one nerve. It was only by examining the nerves at their roots, that is, where they arise from different tracts of the brain and spinal marrow, and before they coalesce, that this philosophic anatomist succeeded in demonstrating their distinct functions. In the face, the nerve of motion passes by a circuitous route, apart from the nerve of sensation, to be distributed to the muscles; and, therefore, the distinct characters of these two nerves were, as sir C. Bell asserts, more easily proved by experiment than in any other part of the body.

The nerves of sensation then feel, or rather recognise, those actions of the muscles which are excited through the medium of the nerves of contraction, and these nerves of contraction, as far as the voluntary muscles are concerned, obey the commands of an immaterial being—mind, spirit, soul; in the lower animals, so far as we know, this principle is transient, for they have no ideas of life, or of death, or of futurity; but in man, the soul is immortal, and for the future bliss of this immortal essence revelation affords a certain guide.

Now the sense of touch and the muscular sense have, by most writers, been confounded together; hence, we are told that weight is determined by touch, but this is erroneous; it is determined by the muscular agency and sense, under the dictation of the will. The abbé Nollet says of touch, that "it not only puts it in our power to judge of what makes an

impression upon us, but also of what resists our impulsions." Here the sense of touch and the muscular sense are confounded together. The agency of touch has nothing to do with weight or resistance; and herein we differ from Dr. Fleming, and agree with sir Charles Bell, by whom, indeed, this muscular sense was first demonstrated. To feel, or touch, is not to resist or struggle. Laocoon, striving with the serpents, resists—his muscular sense is called into action, as is that of the wrestler when engaged in a trial of skill or strength; but what has muscular feeling to do with that tact, which distinguishes between the texture of tissues, or the smoothness or roughness of bodies? For ourselves, we refer the sensations of hardness and softness rather to a muscular sense than a simple sense of touch; but, as we have said, the sense of touch and the muscular sense, or sense of resistance, inter-amalgamate with each other, nevertheless, there is a definite muscular sense of which every one is conscious, and it is by the education of this sense that the infant learns to walk, the man to ascend the lofty ladder, or traverse the ledge of the precipice. It is not connected with feeling alone, but also with sight; and, indeed, the senses of sight, feeling and support, or resistance, are in as close relationship, as are those of smell and taste. This is exemplified in the fencer, whose muscular sense obeys his eye, and in the artist, who strikes out the bold outline of a figure on the canvass.

This muscular sense is sometimes called the

sense of motion; and rightly, because it is a feeling of muscular action; not a feeling of extraneous bodies, but a feeling of what passes within ourselves, as far as such feeling is permitted (many internal operations go on without our consciousness)—a feeling of what we do, according to our will, and the permission of God Almighty. Does the uninstructed man, who looks upon and admires a lovely landscape, think about the inverted picture on his retina? No. Does the athlete who lifts a great weight think of the biceps, or the deltoid, or the pectoral muscles? No. But does he not feel, while he strives, while he struggles, while he runs, an internal consciousness of action totally distinct from touch?

This perception is termed by sir Charles Bell the "muscular sense." He thus illustrates his idea: "When a blind man, or a man with his eyes shut, stands upright, neither leaning upon nor touching aught, by what means is it that he maintains the erect position? The symmetry of his body is not the cause. The statue of the finest proportion must be soldered to its pedestal, or the wind will cast it down. How is it, then, that a man sustains the perpendicular posture, or inclines in a due degree towards the winds that blow upon him? It is obvious, that he has a sense by which he knows the inclination of his body, and that he has a ready aptitude to adjust it, and to correct any deviation from the perpendicular. What sense, then, is this? for he touches nothing, and sees

nothing; there is no organ of sense hitherto observed, which can serve him, or in any degree aid him. Is it not that sense, which is exhibited so early in the infant in the fear of falling? Is it not the full development of that property which was early shown in the struggle of the infant, while it lay in the nurse's arms? It can only be by the adjustment of muscles that the limbs are stiffened, the body firmly balanced and kept erect. There is no other source of knowledge but a sense of the degree of exertion in his muscular frame, by which a man can know the position of his body and limbs, while he has no point of vision to direct his efforts, or the contact of any external body. In truth, we stand by so fine an exercise of this power, and the muscles are, from habit, directed with so much precision and with an effort so slight, that we do not know how we stand. But if we attempt to walk on a narrow ledge, or stand in a situation where we are in danger of falling, or rest on one foot, we become then subject to apprehension; the actions of the muscles are, as it were, magnified, and demonstrative of the degree in which they are excited.

"We are sensible of the position of our limbs; we know that the arms hang by the sides, or that they are raised and held out, although we touch nothing and see nothing. It must be a property internal to the frame by which we thus know the position of the members of our body; and what can it be but a

consciousness of the degree of action, and of the adjustment of the muscles? At one time, I entertained a doubt whether this proceeded from a knowledge of the condition of the muscles, or from a consciousness of the degree of effort which was directed to them in volition. It was with a view to elucidate this that I made the observations which terminated in the discovery that every muscle had two nerves; one for sensation, and one to convey the mandate of the will, and direct its action. I had reasoned in this manner: we awake with a knowledge of the position of our limbs; this cannot be from a recollection of the action which placed them where they are; it must, therefore, be a consciousness of their present condition. When a person in these circumstances moves, he has a determined object, and he must be conscious of a previous condition before he can desire a change, or direct a movement."

In walking, riding, swimming, and other bodily exercises; in writing, playing on the piano, or any other instrument of music, the muscular sense is called into activity, and co-operates with the senses of sight, touch, etc. Muscular exertion is in itself pleasurable, when not pushed too far; and, indeed, the healthy condition, both of the body and mind, results from muscular exertion, and the alternations of activity and repose. The appointment of man, after the fall, to a life of labour, was a judgment tempered by mercy. Man is not destined to lead a life of sloth or supineness, but, urged

on by his natural wants, he cultivates the ground, he tames the wild beast of the forest or mountain, he builds houses, he constructs ships, he clothes himself with fabrics, he surrounds himself with the comforts, the decencies, the luxuries of life, and in every work which his hands find to do his muscular sense is in requisition; it is this sense which appreciates resistance, which enables us to balance our bodies, to move with gracefulness, to run, to walk, to leap, to throw the shuttle with precision, or wield the hammer with skill. It is improved by education; the child learns first to walk, and then to run and leap, and in due time to know its own strength, and also the best mode of employing that strength, without reflecting upon the laws of mechanics, or any philosophic theories. It is evident, then, that we have "a perception of the condition of the muscles previous to the exercise of the will," and that with respect to the hand, "it is not more the freedom of its action which constitutes its perfection, than the knowledge which we have of these motions, and our consequent ability to direct it with the utmost precision."

That the lower animals are endowed with this muscular sense cannot be doubted. It enables the tiger to spring with accuracy upon his prey, the cat upon the mouse, the greyhound in pursuit of the hare when to make the fatal snap, and the horse to leap the fence, which his eye tells him is within his power; it teaches the loris to creep upon its victim, as slowly but

as surely as the hand on the clock-face traverses the dial-plate, and attains the given number; it is immediately connected with instinct, and man, when he steps aside to avoid a threatened stroke, or raises his arm to parry a blow, puts the muscular sense into exercise.

The muscular sense is, to use a homely expression, an every-day working sense; touch and sight are its prime supporters, and to these in turn it lends its aid. Nevertheless, to a certain degree it is independent of them; the infant seeks the breast as it were by an instinctive impulse, or applies the coral to its mouth; and in the dark as well as in the light, we transmit our food directly and precisely to the organs of mastication and deglutition, without thinking upon the manner in which the varied actions are performed, or even transiently noting them. We *will* to perform an act within our power of achievement, and by the complicated action of muscles, nerves, vessels, and bones, we accomplish our object, at the same time, perchance, we know not the origin and insertion of a single muscle, the direction of a single nerve, the course of a single artery.

The muscular sense is, in fact, in perpetual exercise; it is intimately connected with self-consciousness, for we feel that we corporeally exist, that other bodies exist around us, that they resist us, that they lead us to calculate our own powers, nor will all the arguments of the school of Berkeley convince us that we exist only in idea. When Dr. Johnson stamped

upon the ground to disprove Berkeley's idea, he was right.

So much for the senses with which we are endowed, and the information which the mind receives through their respective channels. They teach us all that we know concerning the qualities of matter, and they subserve many of our enjoyments—they are essential to our comfort, our activity, our usefulness; but we gain through their medium no abstract truths, no determinate principles. These are elaborated in the mind itself by its own self-analysis; but, then, they do not teach us our own position as it respects time and eternity. The wisest of the heathens of Greece or Rome lived in doubt, entangled in the mazes of a vain system of philosophy; and though they might believe in a god, or in gods, deducing their arguments as to the existence of an all-powerful Being from the works of nature, and from that internal conviction which seems common to the human race—they knew nothing of His attributes, of his laws, of his requirements, of man's fallen nature, of the intrinsic sinfulness of the heart, of the means of grace, of a hope of glory. They could write noble poems, deep philosophic treatises, histories of empires, narratives of events, details of characters, descriptions of works of art; they could carve statues of matchless perfection, and build temples of surpassing splendour. They displayed an intellectual pre-eminence, which still sheds a lustre over the civilized world. Who by searching can find

out God? Unless God graciously reveals himself to us, a true knowledge of him in our fallen state is impossible; the capabilities of our minds are, after all, but limited; and though, through reflection on the evidences of our senses, we may come to the conclusion that there is an omnipotent Power, we remain in ignorance as to what that Power is, and as to our relationship thereunto. Hence, then, the necessity of information beyond what the mind can gain through the senses, or by its own reflex operations; we are conscious of our position as respects the lower animals, and we have natural longings after and hopes of immortality; the soul whispers to itself, *Non omnis moriar*, I shall not all die; but here, were it not for revelation—a revelation from God, we should be left in darkness.

God gave a revelation of his will to Adam; our first parents transgressed, but then in mercy a promise was given, that the seed of the woman should bruise the serpent's head. God gave a further revelation of his will to Moses, with promises and commands, and elected from among the nations a peculiar people, of whom from the line of Jesse after the flesh should arise the Messiah; in Him are all the promises and prophecies centred, and through him the great revelation of God's purposes of mercy to a fallen world was ordained to be published. The Messiah came; He of whom Isaiah prophesied; the despised and rejected of men—God manifest in the flesh. The prophet's

words were verified, "He was wounded for our transgressions, he was bruised for our iniquities: the chastisement of our peace was upon him; and with his stripes we are healed."*

This is the Christian revelation, which, while it shows us our lost and sinful nature, our utter unworthiness, and the insufficiency of good works for salvation—whilst it humbles our pride, and self-sufficiency, and teaches that our place before God is in the dust, yet it speaks of joy and peace, for it points out what is all-important, the mode of redemption, the forgiveness of our sins, our adoption as heirs of the kingdom of heaven. "In this was manifested the love of God toward us, because that God sent his only begotten Son into the world, that we might live through him."† God reveals himself in his works as a God of wisdom and power; but here he discovers himself as a God of truth, justice, and mercy. He reveals himself as the triune Jehovah, the Father, the Son, and the Spirit, one God for evermore; and he gives us a revelation of the plan of salvation. And what is this plan? it is one by which justice and mercy are reconciled. "Without shedding of blood is no remission" of sins. The Son of God, according to the Divine promise, took upon himself our human nature, dwelt upon earth, sinless, and offered himself up as a sacrifice for sin on Calvary. He "who, being in the form of God, thought it not robbery to be equal with God: but made himself of no reputa-

* Isa. liii. 5. † 1 John iv. 9.

tion, and took upon him the form of a servant, and was made in the likeness of men : and being found in fashion as a man, he humbled himself, and became obedient unto death, even the death of the cross. Wherefore God also hath highly exalted him, and given him a name which is above every name : that at the name of Jesus every knee should bow, of things in heaven, and things in earth, and things under the earth ; and that every tongue should confess that Jesus Christ is Lord, to the glory of God the Father."*

Of the sacrifice of Christ, the crowning sacrifice, those of the Mosaic ritual were types or emblems. By his sacrifice the claims of the law were satisfied. What is required of us? Belief in the atonement. "Jesus said unto Martha, I am the resurrection and the life : he that believeth in me, though he were dead, yet shall he live : and whosoever liveth and believeth in me shall never die."† A true, living, justifying faith is the gift of the Holy Spirit, who sanctifies and renews the heart of the genuine believer. "The carnal mind is enmity against God : for it is not subject to the law of God, neither indeed can be ;" but when the mind is enlightened by grace Divine, the awfulness of sin is perceived and deeply felt, true repentance is awakened, love and gratitude to God for every mercy are excited, and the soul is warmed with adoration. Then does the converted man become prayerful and watchful ; then is he

* Philippians ii. 6—11. † John xi. 25, 26.

zealous in God's cause, and anxious for the conversion of those that live in the darkness of ignorance, and travel along the broad road that leadeth to destruction. Then will he be patient and trustful under trials and affliction, and justify God's dealings with man.

Such are the truths revealed by God himself, which through nothing but direct revelation could have enlightened, cheered, animated, and guided the human affections and will. Man, as an immortal being, has not been left to himself. True it is, that there are many nations still in darkness, and some in the most degraded ignorance. To ask why this is so, is to ask the reasons which determine God in his purposes; we see as in a glass darkly, and the deep things of God are hidden from our eyes; but we are assured that the time will come when all nations shall know the Lord, and Christ shall reign in fulness of glory. Let us be thankful if our trust is in Christ, if he is in us the hope of glory, for "eye hath not seen, nor ear heard, neither have entered into the heart of man, the things which God hath prepared for them that love him."

We have sufficiently shown the necessity of a revelation to man relative to things essential to his eternal interest, but of which he could gain no knowledge by his own mental exertions. We know by internal conviction that we are immortal beings; but unguided by revelation, we shall look forward to the future with anxiety, with a sort of vague apprehension, but revela-

tion dispels anxiety, and fills us with all "joy and peace in believing."

Dr. Abercrombie, in his work on the Intellectual Powers, says: "There is thus, in the consciousness of every man, a deep impression of continued existence. The casuist may reason against it till he bewilder himself in his own sophistries; but a voice within gives the lie to his vain speculations, and pleads with authority for a life which is to come. The sincere and humble inquirer cherishes the impression while he seeks for further light on a subject so momentous; and he thus receives with absolute conviction the truth which beams upon him from the revelation of God, that the mysterious part of his being, which thinks, and wills, and reasons, shall, indeed, survive the wreck of its mortal tenement, and is destined for immortality."

How mysterious is the union between mind and matter! how little we know of ourselves! how shallow is our deepest philosophy! We know that the mind is that part of our being which thinks and wills, reasons and remembers, but we know nothing of it except from these functions. "By means of the corporeal senses it holds intercourse with the things of the external world, and receives impressions from them, but of this connexion also we know nothing but the facts; when we attenipt to speculate upon its nature and cause, we wander at once from the path of philosophical inquiry into conjectures, which are as far beyond the proper sphere as

they are beyond the reach of human faculties. The object of true science on such a subject, therefore, is simply to investigate the facts or relations of phenomena, respecting the operations of mind itself, and the intercourse which it carries on with the external world."

In a philosophic point of view, all our knowledge of the world around us is referable to the operations of the mind on the impressions conveyed to it through the senses, that is, perception. Nevertheless, in point of fact, the knowledge which is acquired by an individual through perception and mental agency, as reflection, memory, etc., is but a small part of what he possesses; it is to the perception and mental labour of others that he owes the great mass of knowledge he is gifted with. Generation after generation has contributed to accumulate a store of facts, a treasury of thoughts and reflections, to which succeeding generations have added, leaving them as a legacy to generations yet to come, who will contribute in their turn to the stock, and bequeath the treasure to their successors. Thus are we enriched by the labour of others, and not altogether by our own experience.

Herein is a wide hiatus between man and the most sagacious of brutes. The brute gains all from personal experience; no generation can build upon the foundation left by a preceding generation—but man can; and it is no objection to allege, that some races remain in a savage state for ages; they possess the

power, the capability, the mental constitution, which the brute does not. Besides, they do improve under favourable circumstances. What were the Anglo-Saxon marauders, our own ancestors? Savages. Is England now a savage country? What were the Celtic British in Cæsar's time? Savages. Were they savages when the Romans had held possession of the island for three hundred years? No; they had adopted the arts, the manners, the civilization of their conquerors. How this very fact of the capability of man to give and receive knowledge demonstrates his superiority in creation. It is true that the human intellect is limited, and that there are mysteries into which he cannot penetrate; nor is it needful for his welfare, his improvement, his happiness, his hopes of a joyful immortality, that he should be able to do so. Let him rely on the oracles of God. Mysteries, indeed, surround him. How fluently does he talk about matter, yet he knows nothing about it, excepting what he gains through his senses; and this knowledge is limited to certain qualities, which may be termed primary and secondary. The primary qualities of material bodies are in themselves essentials, namely, solidity and extension. We cannot conceive of matter, without an involvement of these two properties. The secondary qualities of matter are colour, texture, temperature, smell, taste, etc., properties which differ in different bodies, and which are fluctuating, changeable, uncertain. Of these, and other

properties of matter, as motion, sound, lightness, or heaviness, etc., our senses are the external tests, though mind is, in reality, the discriminator.

"Our first knowledge of the existence and properties of the material world is evidently of a complex nature. It seems to arise from the combined action of several senses, conveying to us the general notion of certain essences, which are solid and extended, or possessed of those properties which characterize material things. Without this general knowledge previously acquired, our various senses, acting individually, could convey to us no definite notion of the properties of external things. A smell, that is a mere odour, for example, might be perceived by us, but would convey nothing more than the sensation simply. It could not communicate the impression of this being a property of an external body, until we had previously acquired a knowledge of the existence of that body, and had come by observation to associate the sensation with the body from which it proceeds. The same holds true of the other senses, and we are thus led at the very first step of our inquiries to a complicated process of mind, without which our mere sensations could convey to us no definite knowledge."*

Here, then, we conclude. Let us give thanks and praise to that God who has made us what we are—instruments of countless strings, all in

* Abercrombie.

harmony, the music of which reaches the soul, and in the secret recesses of the mind is there analyzed, reflected upon, compared, and stored up as knowledge. We feel, we see, we hear, we smell, we taste, we resist; we are assured of our own individuality; we are conscious of our own existence, and we know that all around is external to our own individuality. That sense of individuality is in the mind, and we have within us the assurance of immortality. Let us look to Him, who is the Saviour from an immortality of despair, that at the day of judgment we may be found clothed in his robe of righteousness, the garment of salvation.

CHAPTER IV.

OBSERVATIONS ON THE AGENCY OF THE SENSES, RELATIVE TO THE UNION BETWEEN MIND AND MATTER; AND ON THE OCCASIONAL IMPERFECTION OF THE BODILY ORGANS OF THE SENSES, WITH THE RESULTS DEPENDING THEREUPON.

That the organs of the senses communicate with the mind, through the mediation of certain mysterious filaments, or thread-like bodies, termed nerves, cannot be denied; but the manner in which this communication takes place, the process by which mind receives information from matter, and the subtle operations which enable matter to transfer impressions to mind, are points around which, as it appears to us, the great Author of our being has thrown an impenetrable veil. It is true, that, in consequence of certain discoveries relative to what the older writers termed "the nervous fluid," discoveries which almost go to prove that the "fluid" is of an electric or electro-magnetic nature, a bold theory has been promulgated, namely, that these electro-magnetic currents not only give an impress to the mind or soul, but are in turn influenced by the agency of the immaterial principle, and that

thus the communication between mind and matter is carried on ; in fact, that the link which unites body to mind is a mysterious agent, which (its name is of little importance) cannot be recognised as belonging to the material world. Where revelation leaves a subject untouched, it is, we humbly think, allowable to theorize from facts which science has laid open ; but let us remember that, however we may incline to a theory which seems consonant to science, a knowledge of the limitation of our intellectual powers should lead us to cultivate a spirit of humility and candour. It is something to approximate towards truth ; let us, then, be content to leave much for a future revelation which science on this earth can never unfold before us.

The foregoing observations may be regarded as a slight introduction to a passage on the connexion between the mind and body, well worthy of especial consideration : "In considering the connexion between the mind and the body, it is of the highest importance always to remember that the mind, or rather the being which thinks and wills, is the active agent. The body, with all its beautiful and wondrous adaptations, only supplies the means of perception and of acting. Nerve-matter is the evident medium and instrument of the being that perceives and acts through it. Physiologists appear to have demonstrated that an imponderable principle, akin to electricity, is evolved in the nervous system, and that currents of this

kind are constantly traversing the different sets of nerves, according to their office and function, either as the medium of sensation, volition, or of vegetative life. There is, in short, an action going forward in all the nerves and their centres similar to the electro-magnetic, and, consequently, every nerve is polarized. The soul appears to operate upon these electro-magnetic currents, and to be impressed by them. The *imponderable energia* passing in these currents, is apparently the medium between the soul and the more palpable materials forming the body. This may be inferred from the fact, that whatever alters the force of these currents, alters the condition of the mind in relation to the body. Thus, the arrest of the current in a nerve, subservient to voluntary muscular action, whether by chemical or mechanical means, prevents the mind from exercising will in the use of the muscle, with which the nerve experimented on is connected. The same occurs, also, in the like case with any nerve through which we obtain sensation of the presence of any body, which, in a natural state, would so affect the body as to produce feeling.

"Another evidence that the soul acts through this fluid is afforded in the circumstance, that by strongly directing the attention to any part, as, for instance, the eye, a new sensation is perceived in the organ; and if this kind of attention be persisted in, or frequently repeated, the eye becomes inflamed and painful. It is also

evident, that those nerves which belong to parts, the natural functions of which latter are carried on without our consciousness, such as the stomach, may be rendered sensitive by a strong action of the will; and the operation of all the reflex, or ordinary involuntary system, is modified by mental emotion. In fact, every thought changes the nerve current. Moreover, the brain itself, and all the nerves connected with it, are so far influenced by the will of the individual, as to be not only directed into new modes, so as to effect an entire alteration in the habit of mental and muscular action, but also to such a degree, that the completely organized brain is partly a creation of self-directing and self-repeating mental activity. It is, so to say, developed by the habits of the soul. How necessary, then, is early training! as we bend the twig so is the tree inclined—a trite axiom, but, nevertheless, very true.

"The rapidity of the mental processes seems to require an electric, or some similar medium, by which they may be effected in connexion with the body, since they result so instantaneously, that the will to move, for instance, and the motion, are simultaneous. Professor Wheatstone has proved, that electricity, like light, travels at the rate of 192,000 miles in a second, and this appears to be an agency sufficiently subtle to answer all the purposes of the soul as an active being. Probably electricity and light are but one agent, acting under different relations. It is interesting to consider

ourselves, by each act of our will, as operating upon embodied light; but whatever be the immediate agency between mind and muscle, it is vastly more interesting to know, that willing being is something as really and distinctly existing as the light itself, but in its nature infinitely more subtilely and exquisitely constituted, since it is indivisably and inscrutinably associated with the Being who said, Let light be, and light was!"

"If we advance further in contemplating our mental existence with the body, we shall more clearly perceive that the body itself is not the cause, but the instrument of mind. In order that it should be a ready instrument, it is, as we see, constructed on electro-magnetic principles, so that it serves the purposes of the mind in many spontaneous actions, without even awakening consciousness. Whatever is essential to the processes of life is carried on in the economy without our consent; and until some demand is made by the body, requiring our voluntary interference for the removal of inconvenience, or the supply of aliment, our attention is not so far attracted to the body as that our desires are distinctly perceived to arise from its state. Thus, we feel hunger or thirst, and use means for their removal. But our emotions and affections are at all times influenced by bodily condition, and in many respects may be traced to a physical origin. They are so far involuntary, that their causes are in operation before we are aware, and they

are apt to evince their power against our wills; yet reason is tested by their presence, and she prevails over them, in proportion to the clear perception and experience of spiritual motives, or those moral convictions which arise from religious enlightenment. Were it not that our connexion with the body subjects us to feelings against which we are conscientiously and reasonably required to contend, we should be incapable of that self-consciousness by which we distinguish ourselves from our bodies. In fact, those who find no other inducement to thought and action than the body affords, are really incapable of apprehending any other than bodily existence, and they live not according to spiritual but sensual motive."*

Granting the truth, or the approximation to truth, of the foregoing theory, it is evident, not only that whatever alters the force of the electro-galvanic currents of which the nerves are conductors, alters the condition of the mind in relation to the body, thus making impressions weaker or stronger; but that whatever deranges the tone or "*timbre*" of the nerves themselves, produces mental illusions which are sometimes of a temporary, sometimes of a permanent character. For example, in derangements of the digestive organs, partial loss of sight in one or both eyes, the appearance of black motes, specks, or flies floating in the atmosphere—coloured wavy lines or zigzags—nay, even strange faces, sometimes grotesque,

* Dr. George Moore.

sometimes terrific, palpable to vision like the air-drawn dagger of Macbeth, are by no means unfrequent phenomena.

But, besides these transitory effects of nervous derangement, there are others dependent upon a permanent condition of the nerves, which is not well understood. For example, some persons are incapable of distinguishing between certain colours, while at the same time there is no defect in the construction of the eye, as an optical instrument. Sir J. Herschell examined the eyes of a person affected with this peculiarity, and satisfied himself that all the prismatic rays had the power of affecting them with the sensation of light, and of producing distinct vision. Hence, therefore, as he observes, "the defect arises from no insensibility of the retina to rays of any particular refrangibility, nor to any colouring matter in the humours of the eye preventing certain rays from reaching the retina, as has been ingeniously supposed, but from a defect in the sensorium, by which it is rendered incapable of appreciating exactly those differences between rays on which their colour depends."

The degree of defect in these singular cases is variable, nor are the colours which the sensorium cannot appreciate by any means always the same. Generally, however, red and green are the colours which are not discerned, while blue and yellow seldom fail to make a due impression. Seebeck, on somewhat vague grounds, as we think, divides persons labour-

ing under this defect of vision into two classes. The first consists of individuals who have a very imperfect power of distinguishing the impressions of colours generally; in these, at the same time, the defect is greatest with regard to red and green, these colours being not distinguishable from grey; blue is imperfectly distinguished, and yellow the most perfectly.

The second class consists of individuals who err with regard to the distinction of red from blue; and who, as in the first class, recognise yellow the best. It is not, as we have said, to the eye itself that we are to look for the cause of this defect, but to some mysterious peculiarity of the sensorium, or to some want of harmony between the brain and the optic nerves; but whether the failure is in the energia of the optic nerves, or in the sensorial power of the brain, we pretend not to say. We have, in fact, in this instance, as in so many others, only to confess our ignorance. It is scarcely needful for us to add, that this visual defect is irremediable.

But there are defects of vision dependent upon the structure of the eye itself, as an optical instrument; and under this head we may first notice *myopia*, or *near-sightedness*. *Myopia* results from an over-refractive condition of the eye, the rays of light passing from any object being brought to a focus in the vitreous chamber of that organ, before reaching or impinging on the retina. In this case, either the cornea or the crystalline lens is too con-

vex, or both are in this condition, or the humours of the eye generally are too dense or too abundant, and the pupil is large. Persons thus affected see all objects indistinctly which are viewed at the ordinary distance of distinct vision, but objects held close to the eye are seen with microscopic accuracy. The distance from the eye, when in a normal state, at which objects are surveyed with the utmost distinctness, is from fifteen to twenty inches. An eye which cannot discern objects with ease and accuracy beyond ten inches, may be considered as myopic; but not unfrequently persons affected with myopia cannot regard an object with distinctness which is beyond four, three, two, or even one inch distant from the eye.

To myopic persons, objects brought within their sphere of vision appear magnified; a small type is read more easily than a large type; and, indeed, such eyes see better through a pin-hole in a card than when not thus assisted; the reason is, that the pupil, from its dilatation, admits too many rays of light, but by diminishing the aperture through which the rays of light are admitted, all but those which are the most direct are excluded, and the images on the retina will be, therefore, the more defined. On the same principle, myopic persons, when endeavouring to see distant objects, half close the eyelids, (hence the term myopia, from μύω, I shut, and ὤψ, an eye.) Myopic persons generally see better in the dusk, or at twilight, than others; and their sight, though short, is strong

and good, often lasting. It has been asserted, that as the eye flattens in age, the vision of myopic persons will improve as they advance in life, and the theory, it must be acknowledged, seems feasible, but experience proves that this is not the case; indeed, it would appear that the myopia rather increases than diminishes.

Concave glasses greatly assist the myopic eye; they cause a divergence of the rays of light before entering the pupil, and thus counteract the over-refractive condition of that organ. The degree of concavity best suited to particular cases can only be determined by trials.

From *myopia* we pass to its opposite, *presbyopia*, or far-sightedness, (πρέσβυς, old, ὤψ, the eye,) this being a state of vision to which old age is so commonly subject. In presbyopia the refractive powers of the eye are feeble; that is, the rays of light are concentrated into a focus beyond the retina, and, therefore, too far back for the reception by the latter of a definite impression, at the ordinary distance, of normal vision. This condition may result from flatness of the cornea, from an insufficient convexity of the lens, or from a shorter degree than natural of the antero-posterior axis of the eye itself. The pupil is more or less contracted. The far-sighted person either removes the object under examination further than is usual from the eye, or he avails himself of convex glasses, the effect of which is, to increase the refraction, or convergence of the rays of light, before they enter the pupil. Although this

condition of the eye is common in elderly or aged persons, we are not to suppose that it is confined to such alone. In aged persons it is one of those signs which bid man prepare for his last mortal change—a change, the premonitory warnings of which are beautifully described in the twelfth chapter of Ecclesiastes. But this affection sometimes occurs in the young ; for a time it will remain stationary ; but after a certain period, determined by various concomitant influences, it will greatly increase, till at length, indeed, it may be said, "those that look out of the windows be darkened."

Another defect of vision may be next noticed ; namely, *diplopia*, or double vision. This arises from various causes, some of them obscure, and, perhaps, connected with a morbid affection of the base of the brain, such as a tumor pressing on the *motor oculi* nerve, an inflammatory condition of the brain and its membranes, or a sanguineous or serous effusion involving the origin of the third pair of nerves. It is often the accompaniment of squinting or strabismus, in which, although there is a want of correspondence in the movements or position of the two eyes, the vision of each singly is perfect. Sometimes, however, double vision occurs in one eye only, while, at the same time, there is no disturbance, as far as the harmony of the movements of the two eyes is concerned ; occasionally, both eyes are affected by diplopia. In these cases, there must be some irregularity of refraction, either in the cornea or the lens.

M. Prévost, who published an account of his own case, in the "Annales de Chimie et de Physique," 1832, thought that the diplopia under which he laboured might arise from a fracture, bruise, or partial flattening of the lens, or from a separation of its laminæ. Professor Airy and Mr. Babbage both experience the inconvenience of diplopia; in the case of the latter, both eyes are defective, but he can obviate the defect by looking through a small hole in a card, or through a convex lens. "Professor Airy finds that his eye refracts the rays to a nearer focus in the vertical than in the horizontal plane, and he has ingeniously contrived to remedy it by the use of a double concave lens, one surface of which is spherical and the other cylindrical. The spherical surface is to correct the general effect of a too convex cornea; the cylindrical is to converge or diverge those rays at right angles to the axis; while the parallelism of those which impinge upon it in the plane of its axis is unaffected. Thus the focus of the spherical surface will remain unaltered in one plane, but in the other it will be changed to that of a lens, formed by it and a spherical surface of equal curvature with the cylinder. With the aid of a glass of this description, professor Airy could read the smallest print at a considerable distance, equally as well with the defective eye as the sound one. He found that vision was most distinct when the glass was pretty close to the eye, and the cylindrical surface turned from it.

With these precautions, he observes, I find that the eye which I once feared would become quite useless, can be used in almost every respect as well as the other."

These are defects in vision which, however distressing, and in themselves, that is, as far as the eye itself is concerned, incurable, may be borne with resignation or remedied by scientific agency. But human beings are often called to still greater trials—to total loss of sight—in other words, to perfect blindness. This calamity results from many causes; for example, the cornea may become so opaque as to be incapable of transmitting rays of light into the interior chamber of the eye; or the crystalline lens, also, may become opaque (*cataract;*) disease of the iris, attended by closure of the pupil, will produce blindness, as will also paralysis, or loss of energy, in the retina or optic nerve, (*Amaurosis* or *Gutta serena.*) Accidents may destroy the powers of the eye, and a flash of lightning may produce *Amaurosis;* there are, besides, other causes of loss of vision, into which it is not requisite that we should here enter. In certain cases, blindness is congenital, that is, the individual was born blind, but in most instances blindness comes on at various periods of life, subsequent to the age of infancy. Great as is the calamity of blindness, it is not, we think, so heavy an affliction as total deafness. Privation of sight does, indeed, close one avenue leading from matter to mind, but, perhaps, not the most im-

portant avenue ; we may assume this fact—had Euclid been blind he could still have written on mathematics.

Homer and Milton were both blind, and had Shakspere been blind, the extraordinary creations of his genius would have been what they are—the visions of mighty intellect. An admirably written passage in one of our periodical publications may be here introduced ; it proves that blindness closes but a small inlet to the immortal soul : " We are all familiar with many well-authenticated instances of blind persons having attained to a distinguished position both in literature and science. The celebrated Saunderson, who filled the chair of Newton in the University of Cambridge, lost his very eye-balls by the small-pox, when only twelve years old ; yet before he was thirty, we find him giving public lectures on *optics*, explaining clearly the theory of vision, and discoursing admirably on the phenomena of light and colours—thus furnishing by his own extensive acquirements a convincing proof of the extraordinary powers of language, and of the full efficiency of the ear, as an avenue to the mind. The darkness of the blind, such as instances like this sufficiently show, is but a physical darkness ; they still possess a ready channel, through which the brightest beams of intellectual light may be freely poured : but the darkness of the deaf mute is a mental and moral darkness ; and though he can gaze abroad upon creation, yet it is little more than

mere animal gratification that he feels; he looks not through nature up to nature's God, nor does he participate in that high communion which, through the sublimity of her visible language, she holds with the soul of an enlightened being.

"The reason why the blind usually receive from us a deeper sympathy than the deaf, is, perhaps, because the amount of privation borne by the former can be more accurately estimated. We have only to close our eyes, to shut out for a while the glorious light of heaven, in order to conceive how great that privation must be, but we can never for a moment occupy the place of the uneducated deaf and dumb; we cannot shut out our moral and intellectual light; we cannot dispossess our minds of all that language has conveyed there, nor realize by any effort of imagination the melancholy condition of a being grown up in the midst of society, yet deprived of all power of social intercourse; whose mind has never been elevated by a single act of devotion, nor soothed and comforted by a single impulse of religious feeling. Man naturally 'looketh on the outward appearance;' and when we see the bright eye, and the contented, and even joyous aspect of the dear mute, we forget that we may witness all this in the brutes that perish."

The ear has been happily called the vestibule of the soul, and the annals of the blind who have become illustrious confirm the remark, for they show that few intellectual studies are inac-

cessible to them. It has even been said, and the assertion has received a kind of universal assent among those who have associated much with the blind, that in certain instances they have a facility which others rarely possess. We would not go so far as Huber, who praised the advantages of blindness, but for which, as he says, he might never have become celebrated; nor as Holman, who has endeavoured to make it appear, that in his blindness he possesses advantages over those travellers who have the use of their eyes, most of whom, as he intimates, though they have the use of these organs in perfection, yet "see not."

Huber and Holman availed themselves of the eyes of others, and in this capability the blind have great advantages over the deaf, for their intercourse with the outward world by means of speech is direct, hence they obtain a knowledge of things, theories, and events, which have passed or are passing, of their condition as men, of the requirements of God, and of the appointed mode of salvation. The deaf and dumb *see*, indeed, all that passes within their immediate sphere, but, owing to the imperfect and circuitous mode of communication, (by signs,) by means of which alone access to their mind is gained, little definite information relative to things, events, their condition as fallen creatures, the mode of salvation, and regeneration by the influence of the Holy Spirit, can be communicated. They imitate, as we can testify, the actions of those who attempt to

enlighten them ; they kneel, they raise the eyes, they mimic a solemnity of deportment, and much more, so as to persuade some that they have a clear perception of spiritual truths ; but "faith cometh by hearing," and though we would not presume to assign a limit to God in illuminating the darkest mind, yet we doubt whether the soul can in this life become the recipient of the truths and promises of the gospel in all their glorious fulness.

Deaf and dumb persons are generally irascible, impatient, suspicious, and watchful; they creep about stealthily, and take you by surprise ; they form habits to which they adhere with unflinching pertinacity, and fret if any trifle molests them. They may attain to a certain degree of cleverness, as the word is usually understood, but we know not any deaf and dumb persons (as far as records go) who have attained to any great degree of eminence, even under circumstances favourable to the development of their powers. But with regard to the blind, they have enriched the arts, the sciences, and literature, by their successful pursuits, and not unfrequently under circumstances of extraordinary difficulty. Viewing both these classes of men as devoid of education, dependent upon themselves for support, and for the enjoyment of life, the blind are physically greater objects of compassion than the deaf, because, without peculiar modes of education, suited to their privation, they cannot obtain a livelihood ; but so far as happiness is dependent upon

knowledge, (and from this source some of the purest enjoyments arise,) they are nearly on a level with ordinary men. Through the ear they can acquire knowledge of the highest order, but the case of the deaf is the reverse of this. They are not physically so dependent as the blind; for, having the advantage of sight, they may acquire by application the simpler imitative arts, and thus earn a subsistence; but mentally, their great inferiority, their ignorance of themselves, of all that bears upon the concerns of their existence, and upon the condition, order, changes, and phases of things extraneous to themselves, is painfully palpable to every philanthropic observer of his fellow-beings. The light of the *eye* is theirs, but the light of the *mind* is exchanged for darkness.

We have already intimated, that the obliteration of one organ of sense tends to the greater perceptibility or acuteness of others. This follows almost of necessity, because the loss of any given organ tends to the more finished education of those which are destined to aid it. Thus, in a blind man, the hearing is generally more than usually acute and accurate, as is also the sense of touch; while, at the same time, the muscular sense is surprisingly elevated. Blind guides have been known and celebrated for their extraordinary gifts in the wildest moorland and hilly districts. John Metcalf, of Knaresborough, (1717,) was road surveyor and contractor in the Peak of Derbyshire; he built bridges over rivers, and projected roads over the

ridges of the Pennine chain, nor was he less remarkable for feats of daring, such as hard riding, swimming, etc. This person was blind from infancy. How wonderful is the elasticity of the human mind, which can reconcile itself in such an astonishing manner to the most adverse circumstances, and triumph, as it were, over the loss of that inestimable possession—sight! Many men of note, who were either born blind, or had lost their sight at an early period, have figured in the scientific, literary, and musical worlds. A few of these may be here mentioned (without going back to long past centuries, that is, to the days of Homer, or Diodatus, or even to the more recent time of Henry, the minstrel of Scotland, born blind 1361, or of sir John Gower, of London, who died in 1402.)

Take, by way of example, the following:—Huber, the naturalist (Geneva, 1784–85); he became blind at the age of seventeen; he wrote on the labours and instincts of bees and ants, and also on education. Francis Potter (London, died 1678); he wrote on mechanics, theology, and painting. F. Carulhi (Nantes, died 1789); born blind; he wrote on music. Rev. J. Troughton (Coventry, died 1681); blind at four years of age; he wrote on theological subjects. John Stanley (London, died 1781); blind at two years old; a musical performer and composer; he wrote the oratorios, Jephthah, Zimri, etc. John Gough (Kendal, 1757); blind at the age of three years; a writer of several commu-

nications to the Manchester Society, and to Nicholson's "Journal on Botany and Natural Philosophy." Sir John Fielding (Westminster, died 1780); blind from youth; police magistrate, and author of the "Universal Mentor." John McBeath (Dalkeith, died 1834); blind at an early age; he studied music and mathematics, and wrote on "Inventions for the Blind." He was a blind teacher in the Edinburgh school. James Wilson, author of the "Biography of the Blind." James Holman, whose published travels through many portions of the world have excited very general curiosity and interest. Alexander Rodenback, member of the Belgian Chamber of Deputies, and one of the principal actors in the Belgian revolution; he was a supporter of the democratic party, and often made the chamber ring with his original and eloquent speeches.

We might add greatly to this list, but we select the above merely as examples, to show how, when the acquisition of knowledge is debarred at the entrance of the eye, the mind will collect it through the inlet of other senses. Of the numerous schools of instruction for the blind, of which our country may well be proud—of the systems of training pursued in them—of the labours of pious individuals, some themselves blind—it is not our place here to speak. We devoutly pray that the blessing of the all-seeing God may be with them and upon them!

Blindness is sometimes, but, we are happy to say, not very often, accompanied by deafness—

utter deafness. Blindness is a sad calamity; but when blindness and deafness meet in the same object, what a deplorable picture presents itself to every feeling heart! Blind, deaf, mute! Christian reader, reflect—by what means, by what process, shall access be gained to the undying mind? How can we, by human means, instil into the soul the glad tidings of salvation, demonstrate the corruptness of human nature, the necessity of a new birth, the efficacy of prayer, and the perfections of the triune Jehovah? Think of an immortal soul imprisoned in such a rayless, silent tenement, debarred from all acquaintance with the world around, except as far as feeling may go, and taste and smell. But God often works in a mysterious way, and perhaps communicates light to the mind, when the visual orbs are sealed up in darkness, and the invitations of Christ cannot be heard from the lips of his pious minister—the good shepherd, who is commanded to care for the little ones of the fold. Oh! how thankful to our gracious God ought we to be, for the full use of all our senses—those inlets to the knowledge either of good or of evil, nay, of both; but let us say, "I and my house will serve the Lord!"

The following account is condensed from the "American Annals of Education," and from captain Basil Hall's "Travels in North America." It refers to the deeply touching and most interesting case of Julia Brace, a deaf, dumb, and blind American girl, who resides in the Institution for the Deaf and Dumb

at Hertford, Connecticut: "Julia Brace was seized with typhus fever at four years of age; during the first week of her illness she became blind and deaf; she retained her speech for about a year, (the tongue acting mechanically, according to acquired muscular habit,) frequently repeating her letters, and spelling the names of her acquaintance; but she gradually lost it, and seems now condemned to perpetual silence. For three years she continued to utter a few words; one of the last was 'mother' (that word clung to her tongue; it was the earliest she heard and spoke, and the last that died on her lips!) At first she was unconscious of her misfortune, and imagined that a long night had come upon the world. At length, in passing a window, she felt the sun shining warm upon her hand, and she made signs indicating she was aware of it; she was governed by her mother, by means similar to those employed in the case of Mitchell. At first she was exceedingly irritable, but she became at length habitually mild, obedient, and affectionate. At nine years of age she was taught to sew, (wonderful the conjunct operation of the nerves of sensibility and muscular sense!) and since that time to knit. Julia Brace, who is now nearly thirty years of age, is supported in the Hertford Asylum, in part by the contributions of visitors, and in part by her own labours in sewing and knitting. A language of palpable signs was early established as a means of communication with her friends; this has been much improved

by her intercourse with the deaf and dumb, and is now sufficient for all ordinary purposes. It is obvious, that her means of perceiving external objects are the smell, the taste, and the touch. The touch is her chief reliance, and enables her to distinguish every object with which she has been familiar, sometimes by the aid of her lips and tongue; but her smell also is surprisingly acute, and often enables her to ascertain facts which are beyond the reach of other persons. Her countenance as she sits at work exhibits the strongest evidence of an active mind and a feeling heart, and thoughts and feelings seem to flit across it like the clouds in a summer sky. A shade of pensiveness will be followed by a cloud of anxiety or gloom; a peaceful look will perhaps succeed; and not unfrequently a smile lights up her countenance, which seems to make one forget her misfortunes. But no one yet has penetrated the darkness of her prison house, or found an avenue for moral or intellectual light." Blindness alone is a great calamity. Milton most affectingly deplores his deprivation:—

> ——————— "Not to me returns
> Day, or the sweet approach of ev'n or morn;
> Or sight of vernal bloom or summer's rose;
> Or flocks, or herds, or human face divine,—
> But clouds instead, and ever during dark
> Surround me, from the cheerful ways of men
> Cut off; and for the book of knowledge fair
> Presented with a universal blank."

There are two morbid conditions of the eye of which we ought not here to omit, at least, a passing notice; we allude to *hemeralopia*, (ἡμέρα,

the day, ἄλαος, blind, and ὤψ, the eye ;) or, in other words, day-blindness ; and to *nyctalopia*, (νὺξ, the night, and ὤψ, the eye,) that is to say, night-blindness. We may observe that many modern writers, as Scarpa, and others, have reversed the plain meaning of these terms, and have considered *hemeralopia* as denoting sight during the day, and blindness during the night; and *nyctalopia* as expressing the power of vision by night, but not during the hours ot daylight. In order to prevent any confusion or misunderstanding, we shall drop the scientific terms, which by some are so strangely misconstrued, and adopt their English equivalents. Perfect day-blindness, or owl-sight, as the French call it, is of rare occurrence. Dr. Hillary never met but with two examples ; at the same time he notices a report, that there are a people in the East Indies, and also in Siam, who are subject to the disease of being blind in the day-time, yet who see clearly by night.*

Day-blindness most probably never occurs as a separate disease ; it is immediately the result of a peculiarly irritable state of the retina, insomuch that the stimulus of daylight cannot be borne; and not of the retina only, but of the iris also, which, in order to exclude the rays of light, closes the pupil of the eye to a mere point. All have heard of those singular beings termed *Albinos.*

Albinos are found among all nations, and are noted, from contrast of colour, in African and

* Mod. Univ. Hist. vol. vii.

not unfrequent among the dark tribes of Africa; indeed, it would seem that there are families of negroes in which there is an hereditary tendency to the production of Albino children.*

Among the lower animals, albinism appears to occur most frequently in the race of tame rabbits; they are known by their white fur and red eyes; breeds of these may be propagated; the same observation applies to white mice.

Human albinos, at least, and probably albinos in the animal grade, are affected by a certain degree, more or less decided, of day-blindness. The characters of the albino result from a deficiency in the colouring principle, common to the skin, hair, and eyes. The eyes, for example, are entirely destitute of the dark pigment; in fact, the pink, or red colour, so observable, depends on the fine vessels which are very numerous in the composition of the iris, and on the still greater number of minute arterial ramifications which almost entirely form the choroid membrane, and which, under this condition, are seen through the pupil. To Albinos the state of the eyes is their greatest source of inconvenience. The absence of the black pigment, which has the important office of absorbing superfluous portions of light, renders the eye preternaturally sensible of this stimulus. Strong lights affect the organ painfully; even the glare of open day produces a partial blindness, and the admission of light is

* See Dr. Prichard's "Researches into the Physical History of Mankind," vol. i. p. 366.

intolerable. These evils are balanced in some measure by superior power of vision in dusk, or imperfect darkness.*

Let us now turn to night-blindness. "Nocturnal blindness," says Scarpa, "is properly nothing but a kind of imperfect *periodical amaurosis*, most commonly sympathetic with the stomach. Its paroxysms come on towards the evening, and disappear in the morning. The disease is endemic in some countries, and epidemic, at certain seasons of the year, in others." At sunset, objects appear to persons affected with the complaint, as if covered with an ash-coloured veil, which gradually changes into a dense cloud, intervening between the eyes and surrounding objects. Persons thus affected have the pupil, both in the day and night-time, more dilated and less movable than it usually is in healthy eyes. The majority of them, however, have the pupil more or less movable in the day-time, and always expanded and motionless at night. When brought into a room faintly lighted by a candle, where all the bystanders can see tolerably well, they cannot discern objects at all, or at most in a very feeble manner, or they only find themselves able to distinguish light from darkness, and by moonlight their sight is still worse. At daybreak they recover their sight, which continues perfect all the rest of the day till sunset." †

* On this subject see Buffon, Supplement, tom. iv. p. 559; Pallas in his "*Novæ Species Quadrupedum*," pp. 10, 11, *n.*, and also Blumenbach, etc.

† Cap. xix. p. 322. Ed. 8vo.

Mr. Bamfield observes that the abolition of eyesight by night has occurred in all ages, and is a common disease of seamen in the East and West Indies, the Mediterranean, and in all hot and tropical countries and latitudes, and that it effects more or less the natives likewise of those regions of the globe. It also occurs frequently among soldiers in the East and West Indies, but, according to the information he has received, it is by no means prevalent amongst sailors employed on shipboard. It is not an uncommon complaint among the Lascars employed in the East India Company's ships, trading between India and Europe. Celsus has remarked that females in due health are exempt from this strange affection of the orbs of vision.* It may further be observed, that the inhabitants of northerly latitudes are less subject to night-blindness than are the natives of tropical countries in theirs; but that when the natives of cold climates visit the tropics, they are peculiarly susceptible to this morbid condition of the eye.

But we must now pass from the eye to the ear. Deafness from infancy, that is, total deafness, involves the loss of speech, or of the utterance of a definite language. The deaf do, indeed, utter wild cries, and, as if impelled by instinct, scream with rage, howl with pain or fear, and mutter when pleased; but they hear not the sounds which they themselves utter, and which are often harsh, and even terrible.

* Lib. vi. cap. vi.

The grand object for which the sense of hearing was given to man was for understanding, acquiring, and using language, or speech, for the enunciation of which the lips, the teeth, the tongue, the palate, in fact, the whole organization of the mouth and lower part of the face, is expressly modified, as is also the conformation of the larynx; but, be it observed, that without mind man could never have been a speaking animal. Here, then, we see a design often overlooked by those who study the economy of man. The ox hears, but it could not talk or utter language—that is, sounds modified in accent, in termination, in length—even if it would, for the organization of the vocal organs would prevent the required intonations; but as the lower animals are not destined to think, to argue, to admonish, to persuade—in short, as they are not destined for immortality—in them the faculty of speech would be out of harmony with their real condition and destiny. Language is a mental as well as corporeal exercise, for we have to learn what each sound uttered means, till at length it becomes natural to us, if we may use a popular expression. We have already alluded to the pleasure which the mind derives from music. Now, there are a few observations regarding deafness, or the deprivation of hearing, which cannot be out of place. Total deafness from various causes may take place in a person of mature years, or after he has advanced in life to years of adolescence; in such cases language will be retained, but the

voice will be under no control, no modulation—one sentence may be shouted, another spoken in a whisper.

We may adduce a case in point: an officer (a nobleman) in the battle of Waterloo had his auditory nerve destroyed by the concussion of the air from the bursting of a shell, or from the report of a cannon. He became totally deaf, and consequently lost all control over his voice, which became discordant, and difficult to be understood even by those who were his intimate associates. A similar instance is mentioned by an American writer, in which entire deafness, taking place at the age of eighteen, so affected the articulation, that the individual was no longer intelligible, even to his nearest friends. But, besides total loss of hearing, whether congenital, (that is, from birth,) or occurring at any future period, auditory incapacity manifests itself in various degrees, and under singular modifications. For example, a friend of the writer, who is extremely musical, and plays brilliantly on the piano, is so deaf that she scarcely understands a word of the conversation of persons around her; yet let a discordant note be struck, and she feelingly appreciates it. Another lady, with whom the writer is acquainted, cannot hear the shrill high-toned squeak of the shrew-mouse; and the writer knows some who cannot hear the cries of other shrill-toned animals, as the bat, or mouse, while to deeper, not louder notes, their ears are perfectly awake.

"Dr. Wollaston constructed a small organ, whose notes began where the notes of ordinary instruments end; the notes of his organ increased in sharpness till they became inaudible, though he was certain that it continued to give sound, from feeling the vibrations equally with the lower notes. He thus found that some people could hear seven or eight notes higher than others, and that children could generally hear two or three notes higher than grown-up people. In some persons, the accuracy of the ear is merely impaired in distinguishing faint sounds, and sounds somewhat similar; instances of this kind are particularly evident in infants, whose first attempts at speech are a very remote similarity to the sounds they hear, and become more perfect as their ear is educated, and in some cases remain imperfect through life, in consequence of defect in the organs of hearing. All imperfections of speech do not arise from imperfect hearing; an indistinct articulation may result from various other causes; from carelessness, from defective organs of speech, or from an imperfect formation of those organs; from irregular respiration, producing hesitation, and in some instances proceeding from nervousness."*

The writer is acquainted with a lady, whose organs of hearing are in full activity, but she cannot distinguish one tune from another; her ear appreciates *piano*, *forte*, or *fortissime*, but neither modulation nor rythm. The defect

* See Dr. Arnott's "Elements of Physics," 1827.

here must be in the mind, (a phrenologist would say that the organ of music in the brain was undeveloped,) yet this lady is sensible, pious, and strenuous in her exertions for the extension of the knowledge of Christ.

To revert, however, to the deaf and dumb (or deaf-mute) not deprived of eyesight, we may observe, that these persons, formerly neglected and deemed incapable of instruction, are not now excluded from the school of knowledge and of religion. Men have at length confessed that they possess rational souls—that they are capable of receiving information—and that the mind may be made the recipient of a certain amount of knowledge, varying of course according to the natural powers of the intellect. Not that the amount of knowledge acquired by such persons can ever, *cæteris paribus*, equal that which may be acquired by those who labour under no defect; nevertheless, the inferiority is only one of degree, and is easily accounted for. An able writer makes the following pertinent remarks: "From the advantages which instruction has afforded to a certain proportion of the deaf and dumb for the last half century, a tolerably correct estimate may be formed of their capabilities for improvement. The deaf-mute, living in society, but without instruction, must be regarded as one of the most solitary and melancholy of beings. He is shut out from all but the most imperfect intercourse with his species, and the very intellect, by the possession of which he is raised

above the lower creation, serves only to heighten his calamity, and render the sense of his deprivation more acute. His perceptions of external objects are indeed accurate, but superficial, and confined to a very small sphere.

Of the various arts by which the necessaries and conveniences of life are produced, he can have no knowledge beyond that which is included in the range of his own vision. Animal desires he feels, and he is led by the conventional usages of society to the performance of moral duties, and the avoidance of open and flagrant crime. Thus he becomes experienced, as other human beings are, in what is right or wrong. He sees that virtuous actions have a certain amount of reward in the opinions of good men, for he learns to discriminate between those whose actions are proper, and those who do wrong ; and, again, he sees that in many cases vice meets with disapprobation and punishment among mankind. How this kind of experience shall affect his own conduct, must depend not only on the circumstances in which he is placed, as to example, and the moral influence of those with whom he has to associate, but also on his own natural tendencies. The performance of moral duties implies the exercise of intellectual faculties, and from his birth the deaf-mute makes use of his reasoning powers. He is subject to changes of purpose, to changes of feeling, the pleasures and the infirmities common to his species. He is sensible of kindness ; he gives proof of affection.

That such is the uneducated state of the deaf and dumb might be proved by the observations of their parents, friends, and instructors, in hundreds of instances. That such must necessarily be the case, supposing them not to be idiots, it would be easy to show. We affirm, in contradiction to those who contend that deaf-mutes are naturally more debased than other men in intellect and in morals, that there is not an individual deaf-mute, now under instruction, improving, and thereby evincing rational faculties, who, previous to his instruction, however disadvantageous the circumstances which attended his earlier years, did not evince moral sentiments and intellectual operations. We have traced the history of many of this class, in different ranks of society, down to the period when the deprivation under which they have laboured was first ascertained; and we have invariably found that mixture of good and evil in their actions and tendencies, which is seen amongst other children. We have also had sufficient proofs of the exercise of intellect even while they were in a state of childhood. The parents of deaf and dumb children can sufficiently attest the truth of these observations."

The writer can attest them: he can adduce facts within his own knowledge, proving the correctness of the views entertained by the author just quoted; reasons, however, sufficiently obvious prevent him expatiating on this part of the subject, and, indeed, have influenced him in adopting the words of another,

whose means of observation have been very extensive. We cannot here enter into the modes of instruction employed in order to illuminate the minds of the deaf-mutes; all we need say is, that it is by a system of apt signs, or of hieroglyphics, at least in the commencement; but minds of capacity soon advance still further; reading and writing are acquired—nay, even the power of articulate speech. But we must pass from this part of our subject, on which indeed much might be said.

The senses of smell and taste require a passing notice. We conjoin these senses together, because the latter depends much for its discrimination on the functional perfection of the former; in fact, much of that which in the enjoyment of food is commonly attributed to the sense of taste, depends on the odour carried from the mouth to the nose. If, for example, we masticate any spice, or aromatic substance, as cinnamon, while at the same time the nostrils are strongly compressed, and breathing through those channels obstructed, we perceive no definite flavour from the spice, although the essential oil expressed may sting the tongue and palate. Stoppage of the nasal passages, from catarrh, influenza, or other affections, and preternatural dryness or thickening of the schneiderian membrane, impair or destroy both the sense of smell and taste. We may here observe, that irritation of the schneiderian membrane by ammonia, by snuff, and other things of the like nature, has nothing to do with the

sense of smell residing in the nerves of that membrane: smell is the appreciation of odours, any delicate membrane may be irritated, as, for example, the conjunctiva of the eye. With irritants, scents may be combined; in such admixtures for the stimulation of the olfactory nerves many persons eagerly indulge, and under certain circumstances they are medicinally useful; but it is the perception of scent or odour, irrespective of irritation, which is the proper function of the olfactory nerves.

With respect to taste, this sense resides in a branch of the fifth cerebral nerve, called, from its function, gustatory. For the sensation of taste, moisture must be present; an utterly insoluble body, as crystal, is tasteless; we reduce to a pulp, by means of the teeth and the saliva, the food which we eat, excepting, indeed, such articles as come under the denomination of drink, or, in other words, viands in a fluid state, such as wine, ale, coffee, etc. Perfectly pure water is tasteless.

The contact of two metals in the mouth, producing a galvanic discharge, excites a sensation or flavour which cannot be well described; but the moisture of the saliva is requisite for the effect. It is said, that the superior flavour of porter drunk out of a pewter vessel results from a slight galvanic action going on. Mr. Mayo says, "various substances, after exciting the sense of touch on the fauces, and that of taste on the tongue, are capable of producing a third impression, which is popularly referred

to the palate, but which is really felt upon the sentient membrane of the nostrils." In the case of metals taken into the mouth, this mode of the reception of flavour would appear to take place.

Loss of taste, like that of smell, may arise from various causes; when the mouth is parched up by fever or intense thirst, the sense of taste is greatly impaired, or even altogether suspended; but this condition may be regarded as temporary. A few instances have come under our own observation, in which, though the senses of smell and taste were not obliterated, they were extremely obtuse, insomuch that the most nauseous medicines or offensive odours created no feeling of repugnance or disgust, and the most delicate viands, or the fragrance of sweetest flowers, no pleasurable sensation. In idiots, this loss of taste and smell is far from being uncommon ; but it is not to such that we here allude, nor is it to those who have suffered from repeated partial strokes of paralysis or apoplexy, but to persons of sane mind and sound health. In such cases, the deficiency is either in the sensitive and conducting power of the nerves, or in some a loss of tone in the portion of the brain to which they immediately lead—at all events, a barrier is interposed between organic structure and the mind.

As far as the operations of intellect are concerned, the loss of smell or of taste is of secondary consideration ; these senses administer to our animal enjoyments rather than to the

spiritual part of our being ; nevertheless, mind and body are so united that the breath of early flowers, the incense of the fields, the balmy breeze, the taste of wholesome food, or of the refreshing draught; call forth the feelings of the mind, awaken gratitude, and lead us to offer up our thanks to Him who is the Giver of every good.

With respect to the sense of touch, we have few additional observations to make ; this sense is trained to its highest perfection in those who are born blind, and who from early childhood have acquired the habit of supplying by its exercise their visual deficiency, as far as one sense can compensate for the loss of another. In the educated blind, the faculty of distinguishing minute differences in impression, and of receiving from a given surface of sentient integument the largest number of separate sensations of contact, appears most remarkably developed ; in the blind, too, the exploring movements of touch are performed with the most skill and delicacy. To so high a pitch, indeed, is the sense of touch elevated, that many have been led to believe that the blind are even capable of appreciating colour ; it may be, we admit, that they are able to detect by touch certain differences of texture, which depend on the chemical processes of dyeing, or on certain modes of preparation connected with the impartation of colour to the surface of objects, and thus discriminating or analyzing, may be taught to associate the name of blue

with one sensation, of red with another, and so on—more than this is impossible.

Obtuseness of feeling, or of tact, arises from various causes; the horny hand of the labourer is less discriminative than that of the man who is not called to toil in the field, or work at the anvil. As regards feeling, independent of the pure sense of touch, there is much difference even among individuals, according to the general nervous susceptibility of the frame. Among the North American Indians this susceptibility is less than among Europeans, as may be concluded from the horrid details given by Mr. Catlin, and others, who have witnessed the revolting practices of the red men of the western world.

Loss of feeling, or of tact, in one or more limbs, is the result of paralysis, and other morbid conditions of the system, to which our frail tenement is subject. The same observations apply to the muscular sense, which sense is moreover deranged, or suspended, during a fit of intoxication, (*Proh pudor!*) or when placed on some dizzy height, one, unaccustomed to such a situation, is agitated by extreme terror. The sailor in the rigging of the topmast, the cragsman of the Hebrides, the hunter of the chamois, have learned to surmount such a sense of fear, and are secure in their place of peril. The loss of sensibility, and the loss of the muscular sense, can never pervade the whole frame, till that hour arrives when the soul is about to quit its mortal abode, and enter

the regions of another world. To this condition all are destined—the sentence of death is gone forth! Oh that, while living, while in the enjoyment of our senses, and of the energies of our body, we may "lay hold upon eternal life," and live as "dying daily!" Let us aim at being able to appropriate to ourselves the expression of the psalmist, "My flesh and my heart faileth: but God is the strength of my heart, and my portion for ever."* No one can say this in verity, who is not established on the "Rock of Ages."

The Almighty has not designed that man, even in this his probationary state, should pass through his pilgrimage without experiencing pure pleasures and delights. It is to these that the senses administer, each in its appointed way. The sublimity and the beauty of natural scenery—the grandeur of mountains, forests, and seas—the glory of the sun, moon, and starry expanse above—the works of art, towers, and temples—all these, and more, received into the mind through vision, produce the most delightful emotions. The flowers that strew our pathway, the insects glittering in the sun, the waving cornfields, the grazing cattle, the rustic cottage of the hardy labourer—all combine to fill the soul with pleasure and thankfulness. Can we listen to the roar of waters, to the deep murmur of the wind rushing through the forest, to the song of birds, or the notes of sweet melody, and feel no pleasure—no spirit of praise and gratitude? Is not food sweet to the healthy appetite? Do we not rejoice in our

* Psa. lxxiii. 26.

strength, in the use of our limbs, and in our manual address and precision? Are not the perfumes of flowers, the scent of the bean-field, of the bower of honey-suckle, of the new-mown hay, delicious? Is not the earth full of riches? Has not the Creator adapted it to our pleasures, as well as our necessities, and endowed us with every sense requisite for enjoyment? How delightful to the Christian—how doubly enjoyed by him is nature in all her phases, in all her manifestations, in all her variety! To him nothing is uninteresting, from the mightiest creature to the animalcule, from the cedar to the humble weed; and reflecting that knowledge stores his mind, and pleasure gladdens, refreshes, and animates him, through each respective medium; and delighting in life, and life's enjoyments, he praises God for every bodily and mental endowment, and for all the glorious works which his hands have created—works which lead him to muse upon that inscrutable wisdom, power, love, and consideration, which the Almighty has displayed in fitting the earth for him as his temporary abode—glorious in its mountains, its plains, its seas, and rivers—glorious in the light of day and the darkness of night—glorious in the air and the clouds, in the lightning and the rainbow; but yet an abode to be exchanged by the believer for one infinitely more glorious, in which sin and pain are unknown, and from which mortality is banished for ever.

The senses and the mind