employ, and imbibe by the skin and lungs, has been seen to collect in crystals upon their faces.

Hence, too, the various smells that are emitted from the surface of other animals, and especially that of musk, which is one of the most common. We trace this issuing generally from the bodies of many of the ape species, and especially the simia *jacchus;* still more profusely from the opossum, and occasionally from hedgehogs, water-rats, hares, serpents, and crocodiles. The odour of civet is the production of the civet-cat alone, the viverra *zibetha*, and viverra *civetta* of Linnæus; though we meet with faint traces of it in some varieties of the domestic cat, the felis *catta* of the same writer. Genuine castor is, in like manner, a secretion of the castor fiber; but the sus Tajassu, and various other species of swine, yield a smell that makes an approach towards it.

Among insects, however, these odours are considerably more varied, as well as considerably more pleasant; for the musk-scent of the cerambix *moschatus*, the apis *fragrans*, and the tipula *moschifera*, is far more delicate than that of the musk quadrupeds; while the cerambix *suaveolens*, and several species of the ichneumon, yield the sweetest perfume of the rose; and the petiolated sphex a balsamic ether highly fragrant, but peculiar to itself. Yet insects, like other classes of animals, furnish instances of disagreeable and even disgusting scents, as well as of those that are fragrant. Thus, several species of the melitæ breathe an essence of garlic or onions; the staphilinus *brunipes* has a stench intolerably fetid, though combined with the perfume of spices; while the caterpillars of almost all the hymenoptera, and the larves of various other orders, emit an exhalation in many instances excessively pungent. The carabus *crepitans*, and sclopeta of Fabricius, pour forth a similar vapour, accompanied with a strange crackling sound.

The odorous secretions belonging to the vegetable tribes are well known to be still more variable; sometimes poured forth from the leaves of the plant, as in the bay, sweet-briar, and heliotrope; sometimes from the trunk, as in the pines and junipers; but more generally from the corol. It is from the minute family of the jungermannia, nearly related to the mosses, and often scarcely visible to the eye, that we derive the chief sense of that delightful fragrance perceptible after a shower, and especially at even-tide:* and from the florets of the elegant anthoxanthum *odoratum*, or spring-grass, that we are chiefly furnished with the sweet and fragrant scent of new-mown hay. But occasionally the odours thus secreted are as intolerable as any that are emitted from the animal world; of which the ferula *asafœtida*, or asafetida plant, and the stapelia *hirsuta*, or carrion-flower, are sufficient examples.

To the same secernent powers, moreover, of animals and vegetables, existing in particular organs rather than extended through the system generally, we are indebted for a variety of very valuable materials in trade and diet, as gums, resins, wax, fat, oils, spermaceti. And to the same cause we owe, also, the production of a multiplicity of poisons and other deleterious substances: such, for instance, as the poison of venomous serpents, which is found to consist of a genuine gum, and is the only gum known to be secreted by animal organs; the electric gas of the gymnotus *electricus* and raia *torpedo;* the pungent sting of the stinging-nettle, urtica *urens*, and of the bee, both which are produced from a structure of a similar kind; for every aculeus or stinging point of the nettle is a minute and highly irritable duct, that leads to a minute and highly irritable bulb, filled with a minute drop of very acrid fluid: and hence, whenever any substance presses against any of the aculei or stinging points of the plant, the impression is communicated to the bulb, which instantaneously contracts, and throws forth the minute drop of acrid fluid through the ducts upon the substance that touches them.

As the secernent system thus evidently allots particular organs for the secretion of particular materials, the absorbent system is in like manner only capable of imbibing and introducing into the general frame particular materials in particular parts of it. Thus, opium and alkohol, the juice of aconite, and essential oil of laurel or bitter almonds, produce little or no effect upon the absorbents of the skin, but a very considerable effect upon the coating of the stomach. In like manner, carbonic acid gas invigorates rather than injures, when applied to the absorbents of the stomach, but instantly destroys life when applied to those of the lungs; while the aroma of the toxicaria *Macasariensis*, or Boa upas, of which we have heard so much of late years, proves equally a poison, whether received by the skin, the stomach, or the lungs.

So, also, substances that are poisonous to one tribe of animals are medicinal to a second, and even highly nutritive to a third. Thus, swine are poisoned by pepper-seeds, which to man are a serviceable and grateful spice; while henbane-roots, which destroy mankind, prove a wholesome diet to swine. In like manner, aloes, which to our own kind is a useful medicine, is a rank venom to dogs and foxes; and the horse, which is poisoned by the phellandrum *aquaticum*, or water-hemlock, and corrosive sublimate, will take a drachm of arsenic daily, and improve hereby both in his coat and condition.

It has already appeared, that the secernent vessels of any part of the system, in order to accomplish a beneficial purpose, as, for example, that of restoring a destroyed or injured portion of an organ, may change their action, and secrete a material of a new nature and character. An equal change is not unfrequently produced under a morbid habit, and the secretion will then be of a deleterious instead of being of a healthy and sanative kind. And hence, under the influence of definite causes, the origin of such mischievous and fatal secretions, in some instances thrown forth generally, and in others only from particular organs, as the matter of small-pox, measles, putrid fevers of various kinds, cancer, and hydrophobia, or the poisonous saliva of mad dogs.

But the field opens before us to an unbounded extent, and we should lose ourselves in the subject if we were to proceed much farther. It is obvious, that in organic, as in inorganic nature, every thing is accurately arranged upon a principle of mutual adaptation, and regulated by an harmonious antagonism, a system of opposite yet accordant powers, that balance each other with most marvellous nicety; that increase and diminution, life and death, proceed with equal pace; that foods are poisons, and poisons foods; and, finally, that there is good enough in the world, if rightly improved, to make us happy in our respective stations so long as they are allotted to us, and evil enough to wean us from them by the time the grant of life is usually recalled.

* Hooker's Monography of British Jungerm.



## LECTURE XV.

### ON THE EXTERNAL SENSES OF ANIMALS.

The subject of study for the present lecture is the organs of external sense in animals: their origin, structure, position, and powers; and the diversities they exhibit in different kinds and species.

The external senses vary in their number: in all the more perfect animals they are five; and consist in the faculties of sight, smell, hearing, taste, and touch.

It is by these conveyances that the mind or sensory receives a knowledge of whatever is passing within or without the system; and the knowledge it thus gets possession of is called perception.

The different kinds of perception, therefore, are as numerous as the different channels through which they are received, and they produce an effect upon

the sensory, which usually remains for a long time after the exciting cause has ceased to operate. This effect, for want of a better term, we call *impressions;* and the particular facts, or things impressed, and of which the impressions retain, as it were, the print or picture, *ideas.*

The sensory has the power of suffering this effect or these ideas to remain latent or unobserved, and of calling them into observation at its option: it is the active exercise of this power that constitutes *thought.*

The same constitution, moreover, by which the mind is enabled to take a review of any introduced impression, or to exercise its thought upon any introduced idea, empowers it to combine such impressions or ideas into every possible modification and variety. And hence arises an entirely new source of knowledge, far more exalted in its nature, and infinitely more extensive in its range: hence memory and the mental passions; hence reason, judgment, consciousness, and imagination, which have been correctly and elegantly termed the *internal senses,* in contradistinction to those by which we obtain a knowledge of things exterior to the sensorial region.

Thus far we can proceed safely, and feel our way before us; but clouds and darkness hang over all beyond, and a gulf unfathomable to the plummet of mortals. Of the sensory, or mind itself, we know nothing; we have no chemical test that can reach its essence, no glasses that can trace its mode of union with the brain, no abstract principles that can determine the laws of its control. We see, however, enough to convince us that its powers are of a very different description from those of the body, and Revelation informs us that its nature is so too. Let us receive the information with gratitude, and never lose sight of the duties it involves.

But this subject would lead us astray even at our outset: it is important, and it is enticing; and the very shades in which much of it is wrapped up prove an additional incitement to our curiosity. It shall form the basis of some subsequent investigation,* but our present concern is with the external senses alone.

These, for the most part, issue from the brain, which, in all the more perfect animals, is an organ approaching to an oval figure; and consists of three distinct parts: the cerebrum, or brain properly so called; the cerebel, or little brain, and the oblongated marrow. The first constitutes the largest and uppermost part; the second lies below and behind; the third, level with the second, and in front of it—it appears to issue equally out of the two other parts, and gives birth to the spinal marrow, which may hence be regarded as a continuation of the brain, extended through the whole chain of the spine or back-bone.

From this general organ arises a certain number of long, whitish, pulpy strings or bundles of fibres, capable of being divided and subdivided into minuter bundles of filaments or still smaller fibres, as far as the power of glasses can carry the eye. These strings are denominated nerves; and by their different ramifications convey different kinds or modifications of sensation to different parts of the body, keep up a perpetual communication with its remotest organs, and give activity to the muscles. They have been supposed by earlier physiologists to be tubular or hollow, and a few experiments have been tried to establish this doctrine in the present day, but none that have proved satisfactory.

As the brain consists of three general divisions, it might, at first sight, be supposed that each of them is allotted to some distinct and ascertainable purpose: as, for example, that of forming the seat of intellect, or thinking; the seat of the local senses of sight, sound, taste, and smell; and the seat of general feeling or motivity. But the experiments of anatomists upon this abstruse subject, numerous and diversified as they have been of late years, and, unhappily, upon living as well as upon dead animals, have arrived at nothing conclusive in respect to it; and have rather given rise to contending than to concurrent opinions. So that we are nearly or altogether unac-

* Series III. Lectures i. ii. iii. iv.



quainted with the reason of this conformation, and of the respective share which each division takes in producing the general effect.

The nerves uniformly issue in pairs, one for each side of the body, and the number of the pairs is thirty-nine; of which nine rise immediately from the great divisions of the brain, under which we have just contemplated it, and are chiefly appropriated to the four local senses; and thirty from the spinal marrow, through different apertures in the bone that encases it, and are altogether distributed over the body, to produce the fifth or general sense of touch and feeling, as also irritability to the muscles.

That these nervous or pulpy fibres are the organs by which the various sensations are produced or maintained is demonstrable from the following facts: If we divide, or tie, or merely compress, a nerve of any kind, the muscle with which it communicates becomes almost instantly palsied; but upon untying or removing the compression, the muscle recovers its feeling and mobility. If the compression be made on any particular portion of the brain, that part of the body becomes motionless which derives nerves from the portion compressed. And if the cerebrum, cerebel, or oblongated marrow be irritated, excruciating pain or convulsions, or both, take place all over the body, though chiefly where the irritation is applied to the last of these three parts.

The matter of sensation, or nervous fluid, as for want of a more precise knowledge upon this subject we must still continue to call it, is probably as homogeneous in its first formation as the fluid of the blood; but, like the blood, it appears to be changed by particular actions, either of particular parts of the brain, or of the particular nervous fibres themselves, into fluids of very different properties, and producing very different results. And it is probably in consequence of such changes alone that it is capable of exciting one set of organs to communicate to the brain the sensation of sound alone, another set that of sight alone, and so of the rest. While branches from the spinal marrow, or fountain-nerve of touch, are diffused over every portion of the body, sometimes in conjunction with the local nerves, as in the organs of local sense, and sometimes alone, as in every other part of the system.*

Such an idea leads us naturally to a very curious and recondite subject, which has never, that I know of, been attended to by physiologists, and will at the same time throw no small degree of light upon it:—I mean the production of other senses and sensorial powers than are common to the more perfect animals, or such a modification of some one of them as may give the semblance of an additional sense.

What, for example, is that wonderful power by which migratory birds and fishes are capable of steering with the precision of the expertest mariner from climate to climate, and from coast to coast; and which, if possessed by man, might, perhaps, render superfluous the use of the magnet, and considerably infringe upon the science of logarithms? Whence comes it that the fieldfare and red-wing, that pass their summers in Norway, or the wild-duck and merganser, that in like manner summer in the woods and lakes of Lapland, are able to track the pathless void of the atmosphere with the utmost nicety, and arrive on our own coasts uniformly in the beginning of October? or that the cod, the whiting, and the herring should visit us in innumerable shoals from quarters equally remote, and with an equal exactness of calculation? the cod pursuing the whiting, which flies before it, from the banks of Newfoundland to the southern coasts of Spain; and the cachalot, or spermaceti whale, driving vast armies of herrings from the arctic regions, and devouring thousands of those that are in the rear every hour.

We know nothing of this sense, or the means by which all this is produced: and, knowing nothing of it, and feeling nothing of it, we have no terms by which to reason concerning it.

Yet it is a sense not limited to migratory animals. A carrier-pigeon has been brought in a bag from Norwich to this metropolis, constituting a distance of 120 miles; and having been let off with a letter tied round its neck, from

* See Hunter's Anim. Economy, p. 261, 262.

the top of St. Paul's, has returned home through the air in a straight line, in four or five hours.

Buffon asserts, that a hawk or eagle can travel two hundred leagues in ten hours, and relates a story of one that travelled two hundred and fifty leagues in sixteen hours.

A Newfoundland dog has in like manner been brought from Plymouth to London by water, and having got loose, has run home by land with a speed so rapid as to prove that his course must have been nearly in a straight line, though every inch of it was unknown to him.

At such instances we start back, and, as far as we can, we disbelieve them, and think we become wise in proportion as we become skeptical. Meanwhile, nature pursues her wonder-working course, equally uninfluenced by our doubts or our convictions.*

Even among mankind, however, we occasionally meet with a sort of sensation altogether as wonderful and inexplicable. For there are some persons so peculiarly affected by the presence of a particular object, that is neither seen, smelt, tasted, heard, or touched, as not only to be conscious of its presence, but to be in an agony till it is removed. The vicinity of a cat not unfrequently produces such an effect; and I have been a witness to the most decisive proofs of this in several instances. It is possible that the anomalous sense may in this instance result from a peculiar irritability in some of the nervous branches of the organ of smell, which may render them capable of being irritated in a new and peculiar manner: but the persons thus affected are no more conscious of an excitement in this organ of sense than in any other; and from the originality of the sensation itself find no terms in any language by which the sensation can be expressed.

Sharks and rays are generally supposed by naturalists to be endowed with a peculiar sense in the organ of a tubular structure found immediately under the integuments of the head though they have not agreed as to the exact character of this additional sense. Trevannius calls it generally a sixth organ of sensation. M. Jacobson, and Dr. de Blainville, who quotes his authority, regard it as a local organ of touch. M. Roux, who seems to have examined it with great attention, believes it to be the source of a feeling of a middle nature between the two senses of touch and hearing.† The bat appears to have, in like manner, an additional sensific power, for it is observed to avoid external objects when in their vicinity, while the eye, ear, and nose are closed, and there is no direct touch: and this peculiar feeling has been called a sixth sense generally by naturalists, without discriminating it farther.

What is the cause of those peculiar sensations which we denominate hunger and thirst? A thousand theories have been advanced to account for them, but all have proved equally unsatisfactory, and have died one after another almost as soon as they have received a birth. We trace indeed the organs in which they immediately reside, and know by the sensations themselves that the one exists in the region of the stomach, and the other in that of the throat: but though we call them sensations, they have neither of them any of the common characters of touch, taste, hearing, seeing, or smelling.

* The fact of the migratory power of one kind of animals confirms the fact of the migratory power of others. While the question was confined to birds it was too often denied by many naturalists, merely from the difficulty of accounting for it; and it was said, in opposition to Catesby and White, and all our best ornithologists, that our summer birds only disappear by creeping into holes and crevices to hibernate. And hence, even so late as 1823, the late Dr. Jenner felt himself called upon to examine such assertions with a view of disproving them; which he has done in one of the most agreeable essays on the natural history of migratory birds to be found in our own or any other language. "A little reflection," says he, "must compel us to confess that they are endowed with discriminating powers totally unknown to, and for ever unattainable by, man. I have no objection to admit the possibility that birds may be overtaken by the cold of winter, and thus be thrown into the situation of other animals which remain torpid at that season; though I must own I never witnessed the fact, nor could I ever obtain evidence on the subject that was to me satisfactory; but, as it has been often asserted, may I be allowed to suppose that some deception might have been practised with the design of misleading those to whom it might seem to have appeared obvious?" Phil. Trans. 1824, p. 11. The strongest argument against all such disbelief, arising from the difficulty of accounting for the migration of birds, is to turn to the migration of fishes, and to the parallel cases of remote travel in other animals, which are given above. The respective marvels give support to each other, till disbelief itself becomes at length the greatest marvel of the whole.

† See farther on this subject, Edinb. Journ. of Science, No. iii. Art. iii. p. 87, 1825.



Foods and drinks are the natural and common means of quieting their pain, but there are other means that may be also employed for this purpose, and which are often found to answer as a temporary substitute; as, for instance, pressure against the coats of the stomach in the case of hunger, and stimulating the salivary glands in the case of thirst. It is hence that chewing a mouthful of hay alone, or merely moistened with water, proves so refreshing to a tired horse, and is found so serviceable when we dare not allow him to slake his thirst by drinking. Savages and savage beasts are equally sensible of the advantage of pressure in the case of hunger, and resort to it upon all occasions in which they cannot take off the pain in the usual way.

The manis or pangolin tribes, that swallow their food whole, will swallow stones or coals or any other substance, if they cannot obtain nutriment: not that their instinct deceives them, but for the purpose of acquiring such a pressure as may blunt the sense of hunger, which is found so corroding. Almost all carnivorous beasts pursue the same plan; and a mixture of pieces of coal, stone, slate, and earth is often met with in the stomach of ostriches, cassowaries, and even toads. The Kamtschatkadale obtains the same purpose by swallowing saw-dust; and some of the northern Asiatic tribes by a board placed over the region of the stomach, and tightened behind with cords, in proportion to the severity of the suffering. Even in our own country we often pursue the same end by the same means; and employ a tight handkerchief, instead of a tightened stomach-board.

In consequence of this difference in the mode in which the matter of touch or general feeling is secreted under different circumstances, we may also perceive why some parts of the body, although perhaps as largely furnished with the nerves of touch or general feeling as other parts, are far less sensible and irritable; as the bones, the teeth, and the tendons; and why the very same parts should, under other circumstances, as when morbidly affected, become the most sensible or irritable of all the organs of the system; a fact well known to all, but I believe not hitherto satisfactorily accounted for by any one.

We may see also why inflammation, attacking different organs of the body, should be accompanied with very different sensations. In the bones and cartilages, except in extreme cases, it is accompanied with a dull and heavy pain; in the brain, with an oppressive and stupifying pain; and in the stomach, with a nauseating uneasiness. So, again, in the skin, muscles, and cellular membrane, it is a pain that rouses and excites the system generally; but in those parts which are supplied with the two branches of nerves which are called par vagum and sympathetic, as the loins and kidneys, the patient is affected with lowness of spirits from the first attack of the inflammation.*

Dr. Gall, whose physiological theory has excited so much attention of late years on the Continent, has endeavoured to account for all these varieties of feeling, and indeed for all the animal senses of every kind, both external and internal, by supposing some particular part of the brain to be allotted to each, and that the general character and temperament of the individual is the result of the different proportions which these different parts or chambers of the brain bear to one another. He supposes, also, that this organ is possessed of two distinct sets of nervous fibres—a secernent and an absorbent; both directly connected with what is called the cineritious or ash-coloured part of the brain; the former issuing from it and secreting the fluid of the will, or that by which the mind operates on the muscles; and the latter terminating in it, and conveying to it the fluid of the external senses, secreted by those senses themselves, and communicating a knowledge of the presence and degree of power of external objects. This elaborate theory, and the facts to which it appeals, were very minutely investigated, a few years ago, by a very excellent committee of the physical class of the French National Institute, assisted by Mr. (now Dr.) Spurzheim, the intimate friend and coadjutor of its inventor, and who is well known to have contributed quite as much to the establishment of this speculation as himself. This committee, after a very minute

* Hunter on Blood, p. 289, 290.

and cautious research, gave it as a part of their report, that the doctrine of the origin and action of the nerves is probably correct; but that this doctrine does not appear to have any immediate or necessary connexion with that part of Dr. Gall's theory which relates to distinct functions possessed by distinct parts of the brain.* The origin, and distribution, and action, however, of the nervous trunks have since been far more accurately traced out by Mr. Charles Bell, M. Magendie, and various other physiologists; while, in refutation of the doctrine that ascribes distinct functions to distinct parts of the brain, it may be sufficient to observe, for the present, that many of the nerves productive of different functions originate in the same part, while others, productive of the same function, originate in different parts.

There is no animal whose brain is a precise counterpart to that of man; and it has hence been conceived, that by attending to the distinctions between the human brain and that of other animals, we might be able to account for their different degrees of intelligence. But the varieties are so numerous, and the parts which are deficient in one animal are found connected with such new combinations, modifications, and deficiencies in others, that it is impossible for us to avail ourselves of any such diversities. Aristotle endeavoured to establish a distinction by laying it down as a maxim that man has the largest brain of all animals in proportion to the size of his body; a maxim which has been almost universally received from his own time to the present period. But it has of late years, and upon a more extensive cultivation of comparative anatomy, been found to fail in various instances: for while the brain of several species of the ape kind bears as large a proportion to the body as that of man, the brain of several kinds of birds bears a proportion still larger. M. Sömmering has carried the comparison through a great diversity of genera and species: but the following brief table will be sufficient for the present purpose. The weight of the brain to that of the body forms—

| | | |
|---|---|---|
| In man, from | $\frac{1}{22}$ to $\frac{1}{33}$ | part. |
| — several tribes of simia | $\frac{1}{22}$ | — |
| — dog - - - | $\frac{1}{101}$ | — |
| — elephant - - | $\frac{1}{300}$ | — |
| — sparrow - - | $\frac{1}{25}$ | — |
| — canary bird - - | $\frac{1}{14}$ | — |
| — goose - - | $\frac{1}{360}$ | — |
| — turtle (smallest) - | $\frac{1}{3688}$ | — |

M. Sömmering has hence endeavoured to correct the rule of Aristotle by a modification, under which it appears to hold universally; and, thus corrected, it runs as follows: "Man has the largest brain of all animals in proportion to the general mass of nerves that issue from it."

Thus, the brain of the horse gives only half the weight of that of a man, but the nerves it sends forth are ten times as bulky. The largest brain which M. Sömmering ever dissected in the horse-tribe weighed only 1lb. 4oz., while the smallest he ever met with in an adult man was 2lb. 5½oz.†

It is a singular circumstance, that in the small heart-shaped pulpy substance of the human brain, denominated the pineal gland, and which Des Cartes regarded as the seat of the soul, a collection of sandy matter should invariably be found after the first few years of existence; and it is still more singular, that such matter has rarely, if ever, been detected but in the brain of a few bisulcated animals, as that of the fallow-deer, in which it has been found by Sömmering;‡ and that of the goat, in which it has been traced by Malacarne.§

The nervous system of all the vertebral or first four classes of animals,—mammals, birds, amphibials, and fishes,—are characterized by the two following properties:—first, the organ of sense consists of a gland or ganglion with

* For an examination of the general subject of craniology and physiognomy, see Series III. Lecture xiii.
† Study of Med. iv. 11, 2d edit.
‡ Dissertatio de basi Encephali, 1778, and Tabula baseos Encephali, 1799. See Blumenb. p. 292.
§ Dissert. p. 10. See also Blumenbach, Anat. Comp. § 206.



a long and bifid chord or spinal marrow descending from it, of a smaller diameter than the gland itself; and, secondly, both are severally enclosed in a bony case or covering.

In man, as we have already observed, this gland, or ganglion, is (with a few exceptions) larger than in any other animal, in proportion to the size of the body; without any exception whatever in proportion to the size of the chord or spinal marrow that issues from it.

In other animals, even of the vertebral classes, or those immediately before us, we meet with every variety of proportion; from the ape, which, in this respect approaches nearest to that of man, to tortoises and fishes, in which the brain or ganglion does not much exceed the diameter of the spinal marrow itself.

It is not therefore to be wondered at that animals of a still lower description should exhibit proofs of a nervous chord or spinal marrow, without a superior gland or brain of any kind; and that this chord should even be destitute of its common bony defence. And such is actually the conformation of the nervous system in insects, and, for the most part, in worms; neither of which are possessed of a cranium or spine, and in none of which we are able to trace more than a slight enlargement of the superior part of the nervous chord, or spinal marrow, as it is called in other animals—a part situated near the mouth, and apparently intended to correspond with the organ of a brain. The nervous chord, however, in these animals, is, for the most part, proportionally larger than in those of a superior rank; and at various distances is possessed of little knots or ganglions, from which fresh ramifications of nerves shoot forth, like branches from the trunk of a tree, and which may perhaps be regarded as so many distinct cerebels or little brains.

In zoophytic worms we can scarcely trace any distinction of structure, and are totally unable to recognise a nervous system of any kind. The common and almost transparent hydra or polype, which is often to be found in the stagnant waters of our own country, with a body about an inch long, and arms or tentacles in proportion, appears to consist, when examined by the best glasses, of nothing but a granular structure, something like boiled sago, connected by a gelatinous substance into a definite form.* Hydatids and infusory animals exhibit a similarity of make. The common formative principle of all these may be reasonably conjectured to consist in the living power of the blood alone, or rather of the fluid which answers the purpose of blood; and their principles of action to be little more than instinctive.

Can we, then, conceive that all these different kinds, and orders, and classes of animals, thus differently organized and differently endowed with intelligence, are possessed of an equality of corporeal feeling? or, to adopt the language of the poet, that—

> the poor worm thou tread'st on,
> In corporal suffering, feels a pang as great
> As when a giant dies?

This is an interesting question, and deserves to be examined at some length. It may, perhaps, save the heart of genuine sensibility from a few of those pangs which, even under the happiest circumstances of life, will be still called forth too frequently; and if there be a human being so hardened and barbarized as to take advantage of the conclusion to which the inquiry may lead us, he will furnish an additional proof of its correctness in his own person, and show himself utterly unqualified for the discussion.

Life and sensation, then, are by no means necessarily connected: the blood is alive, but we all know it has no sensation; and vegetables are alive, but we have no reason to suppose they possess any. Sensation, so far as we are able to trace it, is the sole result of a nervous structure. Yet, though thus limited, it has already appeared that it does not exist equally in every kind of the same structure, nor in every part of the same kind. The skin is

* Blumenbach, Anat. Comp. § 203.