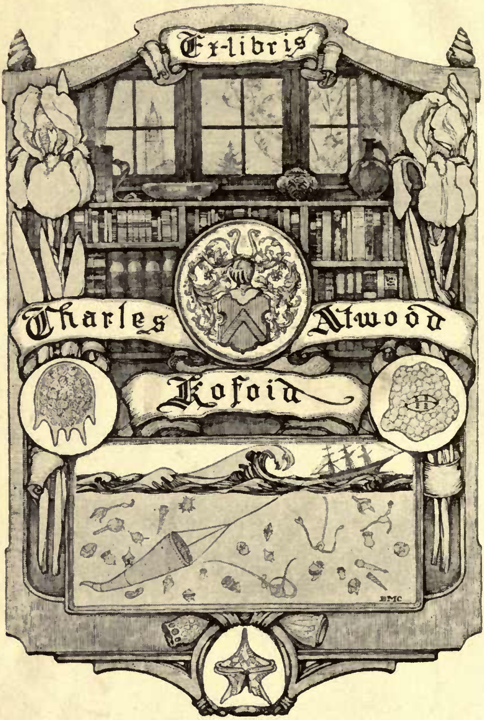
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POPULAR LECTURES

ON THE STUDY OF

NATURAL HISTORY AND THE SCIENCES,

VEGETABLE PHYSIOLOGY,

ZOOLOGY,

THE ANIMAL AND VEGETABLE

POISONS,

AND ON THE

HUMAN FACULTIES, MENTAL AND CORPOREAL,

AS DELIVERED BEFORE

The Isle of Wight Philosophical Society.

BY

WILLIAM LEMPRIERE, M.D.

AUTHOR OF A TOUR TO MOROCCO; OBSERVATIONS ON THE DISEASES OF JAMAICA, &c.; AND ONE OF THE VICE-PRESIDENTS OF THE ABOVE SOCIETY.

THE SECOND EDITION,

TO WHICH HAVE BEEN ADDED TWO LECTURES ON THE MAMMIFEROUS ANIMALS, AS SINCE READ TO THE ABOVE SOCIETY.

LONDON:

PUBLISHED BY WHITTAKER, TREACHER, AND CO. AVE MARIA LANE.

1830.

TO

THE RIGHT HONOURABLE

LORD YARBOROUGH,

D.C.L. F.R.S. AND F.S.A.

PRESIDENT,

TO

SIR. RICHARD SIMEON, BART.

ONE OF THE VICE PRESIDENTS,

AND TO THE OTHER

OFFICERS AND MEMBERS

OF

The Isle of Wight Philosophical Society,

THE

FOLLOWING LECTURES,

ARE

WITH PERMISSION,

MOST RESPECTFULLY INSCRIBED,

BY THE AUTHOR.

PREFACE

TO THE FIRST EDITION.

THE following Lectures, intended as a commencement of discourses on several branches of natural history and the sciences, have been published for those kind friends of both sexes, who, having done the author the honour of being present at their delivery, may be desirous of refreshing their memories by a printed recapitulation; and for the perusal of such general readers, as may take an interest in the subjects, upon which he has proposed to treat.

To the man of science, he has little new to offer. The latter will be fully aware that most of the knowledge we at present possess, must be derived from the collective information of those who have published before us; and that where the more striking features of any particular science only, are to be detailed, however the language may, by different writers be varied, the matter to be correct, ought in most instances to be the same. He therefore will readily discriminate between what portion of the following work is derived from other sources, what share of it the author can honestly claim for himself; and upon a fiat so obtained, he will rest satisfied.

The author here feels it incumbent on him to mention, that the first lecture, viz.—on the Study of Natural History and the Sciences, subsequently to its delivery in the Isle of Wight, was read before the Philosophical Society at Portsmouth, in return for the compliment paid to his own Institution by one of its distinguished members, who favoured it with a very interesting discourse on Light and Vision.

A mutual desire to communicate information, and thus to render knowledge more general and useful, forms one of the leading features of scientific associations; and this necessarily tends to promote that kindly and hospitable understanding between the respective members of each, which at once places ceremony at a distance, and makes a formal introduction altogether unnecessary. The author has been led to this reflection, from the very polite and friendly reception he experienced upon his visit to Portsmouth; where, under the direction of some scientific gentlemen, an excellent institution, (embracing a comprehensive museum and a suitable lecture room,) has been established, that promises great advantages to that important place, and to its very populous neighbourhood.

With respect to the utility of such associations now extending themselves throughout the kingdom, he may be permitted to remark, that as it has been deemed of importance to bestow the light of science on the labouring classes, *it surely is still more essential*, that the middling ranks (upon whom the welfare of society so mainly depends,) should also partake of its beneficial influence; and he is not aware of any pursuit more calculated to enlarge their minds, and to lay the foundation for useful knowledge, than the contemplation of that subject which the above societies alluded to, have principally in view; namely—the works of the creation, the laws by which they are regulated, and the practical applications of which they are susceptible.

Should the author in his humble endeavour, in any degree have called forth in the minds of his readers, the feeling calculated to promote a study so delightful and instructive, he need hardly say, that his ambition will, in the most ample degree, have been gratified.*

* The following is the present establishment of the Isle of Wight Philosophical Society.

President.—The Right Honourable LORD YARBOROUGH.

Vice Presidents { Sir Richard Simeon, Bart.
William Lempriere, M.D.

Treasurer.—T. L. Wateorwrth, Esq.

Secretary.—Abraham Clarke, Esq.

Curators of the Museum { Delabere Blaine, Esq.
Rev. Edmund Kell.

The Society assembles monthly during the winter season for the transaction of business; when a lecture is usually delivered at the Townhall by one of the members upon any subject of natural history, or of general literature, which he may think proper to select.

Newport, Isle of Wight,
August, 1827.

ADVERTISEMENT

TO THE SECOND EDITION.

FROM the very flattering reception of the Author's Lectures on Natural History, he has been encouraged, at this early period, to submit to perusal a second edition, to which have been added two Lectures on the Mammiferous Animals, as since delivered before the Philosophical Society, of which he has the honour to be one of the Vice Presidents.

He has only to hope, that the publication of the two additional Lectures, may not weaken the favourable impression which the former ones appear to have made; and that the whole will tend to promote the object which, as before intimated, the Author has had chiefly in view; namely, the study and contemplation of nature, in all her various attributes.

Newport, Isle of Wight,
January, 1830.

CONTENTS.

LECTURE I.

On the Study of Natural History and the Sciences.

LECTURE II.

On Vegetable Physiology.

LECTURE III.

On Zoology.

LECTURE IV.

On Animal and Vegetable Poisons.

LECTURE V.

Animal and Vegetable Poisons, concluded.

LECTURE VI.

On the Human Faculties, Mental and Corporeal,

LECTURE VII.

On the Mammiferous Animals.

LECTURE VIII.

Mammiferous Animals continued.

LECTURE I.

ON THE STUDY OF NATURAL HISTORY AND ITS RELATIVE SCIENCES.

Mr. President, and Gentlemen of the Society,

It having been considered desirable, at the commencement of our meeting, to take a retrospective view of those circumstances which have more immediately led to the formation of the Society, as well as its presents pursuits; I shall previously to my entering upon the subject of this day's paper, briefly explain to you their nature and import.

In the advanced state of knowledge which distinguishes the present from all preceding ages, it could not be expected that our Island, so replete with natural productions, and so inviting to the philosophic traveller, should long remain unexplored; and it having been ascertained that it abounded in a variety of plants, minerals, and fossils, highly illustrative of the laws of nature, and afforded an interesting scope for the geological enquirer; some gentlemen of Newport who had directed their attention to scientific pursuits, agreed to collect specimens of the various branches for the purpose of establishing a small museum, such as might throw more light upon the natural history of the Island; and to meet periodically, and communicate to each other their ideas on the subject. Such was the basis upon which the present Society was originally founded; and, though then confined to the island productions only, its tendency, and the discussions to which it gave rise, were well calculated to contribute to philosophical improvements in general.

But the establishment of societies in various parts of the kingdom upon a more enlarged scale, which should embrace every branch of useful knowledge, and the rapid success and obviously good effects of one of those associations in a neighbouring town, naturally suggested the utility of not confining the Island Institution to local investigations only, or simply to natural history; but that the door should be open to every branch of science within the compass of its members, or upon which lecturers could be found who were able and willing to assist it with their knowledge and talents.

Under this comprehensive latitude, natural history, embracing the whole of the attributes of the Deity as far as can be recognized by our limited senses, the laws by which they are governed, and their practical utility and application to human purposes—natural philosophy, which explains the relative operation of created substances upon each other, and reasons upon the causes by which those operations are produced—and all human inventions, improvements, and acquirements, have been considered fit subjects for investigation and discussion: though natural history, and the different sciences immediately connected with it, in a society constituted as ours is, may be considered the most applicable and useful.

In consequence of this arrangement, besides those now submitted to the public, very interesting lectures on geology, chemistry, ancient and local agriculture, the island barrows, poetry, and on the origin of language, have been delivered at the monthly meetings by members who have paid attention to those subjects: and others are expected, which, from the high literary attainments from the gentlemen from whom they are likely to emanate, promise much intellectual gratification, and practical utility to the Society; and to the respective families and friends of the members who are usually invited to attend the lectures.

If we take a view of the universe under our present improved knowledge, and of the well known capabilities of the human mind; we may be hastily led to express our surprise that so many ages have been allowed to pass by, before science had shed its full lustre on the intellectual world. But experience has taught us it was intended, that human acquirements should be slow and progressive; that we should be the better prepared for the exercise of faculties through the agency of which, in a future and more elevated condition, we should be rendered worthy of those divine attributes, which, we are taught to believe, are to form the chief sources of our ultimate happiness; and that in the physical as in the moral world, the operations should be at one time advancing, and at another, retrograding; until such an order of things was produced, as should complete and render perfect the noble purposes for which the universe was created.

Hence man, unlike the other branches of animate nature in which the physical powers were principally to be called into action, came into the world a weak and helpless creature, entirely dependent on others for the immediate preservation of his life, and ultimately, upon his own labour and ingenuity for its continuance; and hence, human knowledge was in the beginning confined to the wants and necessities of the species, and made but little progress until mankind had begun to feel the comforts of social life, and by a more frequent communication of ideas, had acquired the habit of collecting and recording facts, and eventually of reasoning upon their phenomena and causes.

Upon the earliest development of intellect, natural history would be the first to engage the attention of mankind; since, independently of the supplies which the productions of the earth afforded to his wants, to class which would be necessary to render them applicable to human purposes, the grandeur and variety of the surrounding objects, the order in which they are arranged, and their uniform obedience to some fixed law, would naturally awaken the curiosity and fix the attention of the intellectual observer, long before he had acquired the power of ascertaining the particular properties of each, their corresponding action upon each other, or of enquiring into the causes which might have led to their production.

We accordingly find that, at a very early period, the animal, vegetable, and mineral kingdoms had been subjected to something like arrangement. Most of the animals, intended for the support of the species, had been domesticated and received appropriate names; while others, decidedly offensive, had their proper denominations, and rules by which they might be avoided. Vegetables in great varieties had been called into use both for culinary and medicinal purposes; and many of their poisonous tribes had been discovered and clearly distinguished from those which were harmless. The use of some of the minerals had also been ascertained; and the heavenly bodies and their various movements had not altogether escaped observation, though subjected to a fanciful arrangement, and to a total ignorance of the principles by which they were regulated; while the whole face of nature, and many of its phenomena, had called forth the most elevated sentiments that ever graced the human pen.

But still the knowledge of mankind was extremely limited. The sciences had hardly made one advance towards existence; and a vast variety of the productions of the earth, which since have been converted to the most useful purposes, had not, even in their more simple state, been discovered, or at least been rendered applicable to human conveniences.

As man became more associated, emulation, and a variety of new propensities, would arise, and call forth his exertions to make discoveries of substances that might be rendered subservient to his taste, to his appetite, and to his desire for pre-eminence; and his wants being more than supplied, his attention would be gradually directed to luxuries, and to those improving means of attack and defence which the advancing state of society, and the competition to which it would give rise, might render necessary; thereby bringing into use a great variety of natural productions, of the application of which in former times he was totally ignorant.

As population increased, he would from necessity extend his dominion over a larger space of territory, and thus enlarge his knowledge of those animals, vegetables, and minerals, which the countries newly occupied presented to his observation. Encouraged by such discoveries, and his wants increasing with the means of gratifying them, he would not long be satisfied with the supplies which the surrounding country afforded him. He would soon discover that the sea opened to him great varieties of food, to which in his earlier and more simple state of existence he had been an utter stranger; and which, by a little ingenuity and increasing confidence, afforded him an opportunity of visiting countries previously out of the reach of his ordinary contemplation.

The earth, from the surface of which he at first only obtained his supplies, it was ascertained by gradual penetration, contained within its bowels a great variety of substances which, as mankind approached towards civilization, was converted to the most useful purposes; and the subsequent barter of one article for another (the basis of modern commerce,) gave an additional impulse to the desire of discovery, and by increasing human knowledge, led at a very early period to a general acquaintance with natural history in its more ordinary acceptation.

But it was not until mankind had considerably advanced in civilization, and had recorded a vast collection of facts from the experience of many ages, that any thing like system was even contemplated; much less a knowledge of the structure and economy of the different animate and inanimate substances which constitute the most important and most interesting part of modern natural history; and which, considered as the pillar stone of all human knowledge, and as affording the most rational sources of instruction and amusement of any perhaps that can be brought under contemplation, is a study to which I *now* most particularly wish to invite your attention.

For the sake of illustration, let us picture to ourselves the effect upon our minds, had we, upon the earliest dawn of reason, possessed the *intuitive* faculty of comprehending at *one view* the existing order of things—of explaining to ourselves the laws by which they are governed—and of classing and arranging the different objects, so as to admit of easy reference whenever it suited our wants, or awakened our curiosity. We should be immediately struck with the grandeur, order, and contrivance of the objects which surrounded us, and with the benevolence and omnipotence of Him by whom they were created.

Commencing our observations at the silent hour of night, when all terrestial objects are obscured under the veil of darkness, and animate nature is sunk into repose; our eyes would be irresistibly directed upwards. And *there*, the vast expanse of heaven, studded and adorned with innumerable luminaries of various magnitudes and at indefinite distances, each subservient to fixed laws, and formed for purposes beyond all human comprehension, would at once awaken our curiosity, and prepare us for those still no less wonderful attributes which the divine hand has so liberally and so benevolently bestowed on the universe.

As these heavenly objects disappeared from our astonished vision, our attention would be *instinctively* directed to the eastern horizon, now gradually enlightened by the approach of a new luminary of far greater magnitude and powers than any we had yet contemplated;—too vivid, indeed, to be examined by our weaker sight, but whose influence is at once brought home to our senses and conviction—bestowing light, life, and activity upon all nature, and at once displaying a scene of unparalleled grandeur and comprehensiveness—such a variety and order of things—so many causes and effects—so much contrivance with useful results—and such a subservience to one grand system, as at once with language irresistible to bespeak the omnipotence of the Creator, and to sink all human attributes into comparative nothingness and insignificance.

In every direction we should observe something on which to fix our attention or to awaken our curiosity, to elevate and add dignity to our sentiments, or to call forth our most unqualified devotion. Countries of unbounded extent, a very limited proportion of which can be embraced by our imperfect vision, would present to our observation, in some parts, mountains of almost interminable elevation, whose summits are enveloped in perpetual snow; with corresponding vallies, whose abysses cannot be contemplated without horror.—In others, more moderate elevations, which, while they add variety to the scene, attract and give direction to those winds, which, charged with moisture, drop fertilizing showers on the vales below;—or, upon extensive plains, clothed with vegetation in all its shades and varieties, possessing vitality, growth, and the power of regeneration to an indefinite degree; and supporting a still higher class of animate substances which, from the important place they hold in the creation, deserve a separate notice.

This unparalleled display of beauty would be further diversified by noble forests, which, while they confer grace and dignity on the surrounding objects, combine, with the other parts of vegetation, the most useful capabilities; or, by innumerable streams, which, in due season overflowing their boundaries, irrigate and fertilize the soil with which they come in contact, and uniting, return their superfluous waters in majestic order to their grand receptacle, the ocean, from which they derived their supply.

Extending our eye beyond the boundaries of terrestial objects, we should be lost in wonder and admiration in contemplating that immense and interminable mass of water with which we are in every direction surrounded: at one time, calm, tranquillizing, and inviting; at another, majestically terrible—threatening us by the magnitude and rapidity of its movements with instantaneous destruction, yet from some unknown cause, and as if by enchantment, when most appaling, arrested in its progress, and, like a vanquished enemy, retracing its steps back to its former position.

Such are the appearances which our first introduction to the natural world would present to our observation.

But there is one feature to be described which, as being more brought home to our senses than any yet noticed, and as being of a less tangible nature, would excite in us a greater share of wonder, and an increased curiosity to become acquainted with its properties and laws. For in the midst of our contemplations, we should find ourselves surrounded with an invisible substance, from which alone we and all animate nature breathe and have life; and which, pressing in every direction, preserves the equilibrium of the whole machinery, as well as confines to its own proper sphere each minuter part; while its constituent principles form the great sources of those various combinations which are requisite to preserve and perpetuate the existing order of things.

All these indeed are subjects well calculated to excite our wonder, to awaken our curiosity, and to inspire in our minds the most elevated sentiments of devotion towards the Author by whom they were created. Yet much as may be their due, and we cannot dwell too long upon their beauties, there is yet *one* subject to be treated, which, from the comprehensiveness of its nature, from the contrivance it displays, and from the usefulness of its tendency, far exceeds any we have yet noticed.—We allude to the animal creation.

Had our first view of the universe been confined to the objects previously noticed, we should have indeed had a vast field for contemplation. But when the novelty which it excited had begun to subside, and reflection had superseded our curiosity, though admitting the grandeur of the design, we should at once have discovered a deficiency, that would have rendered us doubtful of the purpose; and while we admired the picture, we might have been led to question the judgment of the artist.

But when we see this unparelleled display of beauty, order, and contrivance, enlivened and adorned by an endless variety of *other* substances, possessing life and locomotion, and great capabilities of enjoyment, deriving support from the various productions which surround them, and conferring life, grace and dignity upon the other parts of the picture;—and when among these, we discover man, the wonder of the creation, weak indeed comparatively in physical powers, but in divine attributes only inferior to the great Architect himself;—and that while each portion of the creation has thus its own peculiar laws and movements to answer some individual purpose, it is rendered subservient to the general harmony and usefulness of the whole;—conviction then would be brought home to our minds of the design and ends for which the universe was contemplated: and while we with all due humbleness acknowledge the wisdom of the measure, and the benevolence by which it was dictated, our curiosity would irresistibly be awakened to examine more minutely those different appearances which had at first excited our admiration—to enquire into the laws and economy by which they are regulated—and to ascertain, if practicable, the uses and purposes for which each particular substance was created. This then is what constitutes in our view of the subject, the study of natural history: a pursuit, perhaps, the most noble, instructive, and useful of any, to which the human mind can be directed. Noble—in so far as it teaches us, in language the most convincing, the works of our Creator, and the existence of a supreme Being to whom we owe unbounded love, veneration, and obedience. Instructive—as it affords us lessons, the most impressive, of wisdom, benevolence, and good-will towards mankind, well deserving of our imitation. And useful--since its application is referable to all the wants of our species, artificial or natural, as well as to those acquirements and improvements which, calling forth the intellectual powers of man, place him where he was intended to be placed, at the head of the creation.

Practically considered the husbandman would very unprofitably pursue his occupation, were he ignorant of the different soils which it is his interest to cultivate, of the various articles necessary to render it more productive, of the seasons most suitable to put in his seeds, of the relative difference in the vegetable substances thereby to be produced, or of the distinctive character of the various animals which are to constitute his herds and flocks. In a like manner, the success of the gardener depends on his intimate knowledge of the vegetables, fruits, trees, and flowers in their minutest economy, from which alone he can obtain a livelihood. And even the peasant must know something of natural history to enable him to manage his small property, to produce the vegetables, fruit, and honey, which are so essentially necessary to contribute to the support of his family.

The physician would practice empirically and with danger, did he not make himself acquainted with the minute properties and capabilities of the various substances to which he must have recourse for the removal of diseases. The manufacturer would make no progress in his arts without a similar knowledge. Nor would the mechanic bring to perfection his very useful labours, were he ignorant of the external character and common properties of the materials to be worked by his hands. "The objects of nature form a leading feature of reference for the painter and the poet;" and to the philosopher and the divine, afford some of the finest illustrations to which they can have recourse. In a few words, natural history is the basis upon which alone the arts and sciences and all human knowledge are founded." It forms the more or less every day business of life; and while it proves a never-failing source of the most rational amusement, it teaches us by lessons the most instructive and conclusive, the divine origin of our nature, excites in our minds the most exalted sentiments of benevolence and devotion, and gradually prepares us for that more elevated condition, when the attributes of the Deity in all their glory and comprehensiveness shall be opened to our understandings, and secure to us that felicity to which, in this probationary world, we can only look forward in perspective. Natural history, therefore, cannot be too comprehensively studied; it should form a part of our earliest education, and throughout our lives, the various objects which it presents should be constantly before our eyes, and be the subject of our most serious contemplation.

Having endeavoured to impress on your minds the tendency and usefulness of the subject, we will now notice the different heads under which it has been usually arranged.

By natural history, we mean a description and arrangement of those created substances, animate and inanimate, which can be immediately recognized by our ordinary senses, and which, from their external character, and relative situation, will admit of easy classification and comparative distinction; or, in other words, of those substances and appearances, which naturally present themselves to our more ordinary and daily observation.

Thus the heavenly bodies, the atmosphere and its phenomena, the sea and the watery element in general, the mineral, vegetable, and animal kingdoms in all their varieties, form the materials upon which natural history is founded. And from these emanate those comprehensive sciences and all those useful inventions, that progressively have been brought to the perfection in which we now see them.

The science of the heavenly bodies has been denominated *astronomy*, which professes to teach their relative situation, magnitude, distances, motions, and eclipses. To determine these points, has been distinguished by the appellation of *pure* or *plain astronomy*. To investigate the causes of their motion, and the laws by which they are governed, comes under the head of *physical astronomy*.

The appearances of the heavenly bodies were calculated to excite the earliest attention of mankind. We accordingly find, that the ancient shepherds, from residing in a climate in which the brilliancy of the nights and the serenity of the atmosphere invited them to make observations, very soon began to mark down in their memories the various constellations; and by the aid of the imagination, to compare them to some animal or other substance to which they conceived they bore a resemblance, and named them accordingly; and having ascertained that the courses of the different constellations were *apparently* from east to west, according to their relative situation, they soon learned to make their movements subservient to the purposes of travelling by sea and by land, no other guide or rule having at that period presented itself.

Thus was laid the foundation of one important part of astronomy, which has been continued up to the present day; namely, the different appearances and relative situation of the heavenly constellations. But in the infancy of human knowledge, it could not be expected that the planets should be distinguished from those which we now consider to be fixed stars; and it was reserved for more enlightened times to suggest a system by which the movements of the heavenly bodies *in general* might be regulated. And though the earliest attempts of philosophers were influenced more by their common observation than by a knowledge of other sciences, which since have thrown so much light on the subject; yet each new system, as it succeeded the other, led to important discoveries, which very materially contributed to that perfection in the science it has since attained; and which, under the denomination of the solar system, or that principle which makes the sun the centre of attraction round which the earth and all the other planets revolve in their respective orbits, (the stars according to conjecture being separate suns with a planetary system to each,) constitutes the astronomy of the present day.

The utility of astronomy as a science is daily becoming more obvious, and its application to the purposes of navigation and geography is well understood. In its progress it has led to some of the most important inventions; among which the telescope, the planetarium or orrery, the artificial globes, the chronometer, the quadrant, and many other nautical and astronomical instruments bear ample testimony; while the subject itself affords a study highly delightful, and in a very powerful degree calculated to impress on your minds the grandeur of the design upon which the universe was created, and the omnipotence of Him by whom that design was carried into execution.

The atmosphere is that invisible substance which surrounds the globe in every direction to a considerable elevation, whose influence is indubitable, but whose presence will not admit of tangible nor ocular demonstration. The science, by which its properties are explained, has been denominated *pneumatics;* or, if we embrace the whole of its various phenomena, *meteorology.* Its mechanical principles are fluidity, transparency, density, gravity, and elasticity. Its component parts or chemical principles are oxygen, nitrogen, and carbonic acid; in which nitrogen bears the greatest proportion, and carbonic acid in a very considerable degree, the least. By a knowledge of its mechanical powers, we become acquainted with the nature of wind or air set in motion, which, when in excess, constitutes the storm or the hurricane; or, when applied to human purposes, promotes navigation, the propelling of mill machinery, and the like—with its pressure upon all material substances, by which they preserve their position and equilibrium, each portion being confined to its own proper sphere—with the doctrines of sound, &c. In a chemical sense, it is the great instrument of animal respiration, of vegetation, of combustion, and of the different combinations and changes which are constantly taking place in nature: while its electric properties give rise to the formation of lightning, clouds, snow, hail, rain, meteors, and most of those atmospherical phenomena which are more or less daily occurring to our observation. Thus the doctrines of the atmosphere branch out into various subjects which of themselves may be considered so many distinct sciences; for the illustration of which a great many very important instruments have been invented.—Among these, the barometer, the thermometer, the eudiometer, the hygrometer, the air pump, the electrical apparatus, and some ingenious chemical instruments are the most conspicuous. The air or atmosphere, therefore, forms a most essential part of natural history; and being of very comprehensive operation, a study of its laws and properties becomes a matter of deep interest and importance.

We come next to the doctrine of water, the science of which we have denominated *hydrology*. The common properties of this element are fluidity, gravity, transparency, and in its more simple state, insipidity. Its chemical or constituent parts are oxygen and hydrogen, united, as it has been supposed, by the agency of the electric fluid; the oxygen bearing in a very considerable degree the largest proportion. The subjects to which the study of *hydrology*, has given rise, are the doctrines of the tides, currents, depths, and other phenomena of the sea—of the depths and courses of rivers—of hydraulics and of hydrostatics, which relate to the motion, pressure, and gravity of water—and of the principles and application of steam, now of such comprehensive and universal use. The subject, therefore, is highly interesting; and, as being connected with most of the other sciences, its study becomes of great importance.

The earth and its productions are the next subjects for consideration; and these for obvious reasons are deserving of a very particular notice. To explain the artificial divisions of the earth, its seas, rivers, latitudes, and local peculiarities, belongs to the province of geography;—a science too well understood, and the importance of whose study is too fully appreciated to render a further illustration of its utility requisite to an association so enlightened and so well informed as the one which I have now the honour to address. I shall therefore pass over to its *general* productions, which, ranging themselves under three distinct heads, have been denominated the mineral, vegetable, and animal kingdoms; and as minerals, according to the present view of philosophy, were the first created, we will begin with the mineral kingdom. But as we cannot understand the laws by which minerals are regulated, without some previous knowledge of another branch of science to which they have frequent reference, I shall, in a very few words, explain to you its nature and import—I allude to *chemistry.*

Chemistry is that science or art, the object of which is to ascertain the component or constituent parts of all substances; and what effects are produced on them by change of temperature, or by their mutual action upon each other; and the mode and laws by which those changes are effected.

As opposed to natural history, chemistry looks into the most minute and *interior* structure of substances, the changes to which they are subject, and the uses to which the constituent parts separately or in combination can be applied. Natural history explains the *external* character and appearances of those substances as, upon first examination, they strike the senses, their classification and the order in which they are arranged, the situation in which they are ordinarily to be found, and the probable uses for which they were created.

By the above definition of chemistry, it must be considered a science of universal application; since it enters into all the most minute operations to which natural bodies are subject, and into a full explanation of the different changes and operations which are constantly taking place in the grand laboratory of nature; or which, in imitation of her laws, can be produced by art, whether for the purposes of investigation, or for the formation of new substances necessary or useful to man.

Thus we become acquainted with the constituent parts of all animals, vegetables, and minerals—of the atmosphere and of the surrounding waters—of the uses to which each can be applied, and of the changes and results which their mutual action upon each other is constantly effecting. And from this we learn, that the work of destruction and composition of natural substances is constantly taking place, reducing compound into simple bodies, and associating the particles of simple bodies so as to render them compound.

These operations are effected by what has been termed the laws of chemical attraction; or that affinity of bodies for each other which leads to their approximation and union. All substances are governed by the laws of attraction; though those laws are varied according to the circumstances of the case. Thus when a smaller body is simply attracted by a larger one, it is denominated the *attraction* of *gravitation*, as illustrated by the solar system, or more familiarly, by the falling of an apple from the tree to the ground. When bodies of *similar* bulk and weight, and *homogeneous* in their constituent parts, are attracted and unite, forming only an addition of mass to the same materials, it is termed *the attraction of cohesion.* But when *heterogeneous* bodies, or substances of *opposite* qualities, have an affinity for each other, and are brought together in union by attraction forming *new* compounds, this constitutes what is understood to be *chemical attraction,* the basis upon which all the knowledge of the science is founded.

Thus various combinations and changes arising from chemical affinities, are constantly taking place in nature, producing in some instances, simple substances from precipitation; in others, new compounds from combination, by which the material world is more or less in an uniform state of decay and renovation.

To imitate nature in these operations, whether for the purpose of investigating her laws, or to produce substances useful to man, constitutes the *practice* of chemistry: to understand which, it is requisite that we make ourselves acquainted not only with the general principles of the science, but also with the chemical affinities of each particular substance; with the nature and laws of heat and light, by the agency of which combinations are produced;—with oxygen, the basis of vital air, which forms a constituent part of most substances;—and with each simple body throughout nature, with the combinations of which it is susceptible, and with the new substances which those combinations may produce.

To enter into all these particulars would be foreign to my present purpose, which is only to convey to you a general idea of a few of the most useful sciences, and to point out their utility. It will be sufficient to observe, that all material substances, with which we are acquainted, are subject to chemical laws, and afford a most interesting field for inquiry; and that while the philosopher avails himself of its vast resources, chemistry admits of a practical application to every the most common purposes of active life. It is closely interwoven with the arts, from the simplest to the most complicated, and it forms an essential part of our domestic manufactures. Dying, bleaching, tanning, glass-making, printing, brick-making, the working of metals, and innumerable other arts are all dependent upon chemical principles and chemical operations; as are also the more familiar processes of converting milk into butter and cheese, of flour into bread, and a variety of articles into wholesome and nutritious food;—of preserving others for a similar purpose;—and of manufacturing fermented liquors, wine, cider, beer, and the like in all their different varieties.

From a knowledge of chemistry, agriculture and gardening are rendered capable of some of their greatest improvements; since it explains the phenomena of vegetation, including the germination, growth, ripening, and death of plants; the quality and operation of manures; the influence of light, temperature, and moisture upon vegetation; and the principles upon which seeds roots, and plants are to be preserved. From the same source, the physician is supplied with some of his best instruments with which to practice his art; the philosopher finds a pursuit which opens to him the whole fabric of nature, and makes him familiar with its most minute phenomena; while the private individual derives from it many instructive lessons and occupations, which serve to fill up the tædium of life, and to contribute to his intellectual improvement.

Having endeavoured to explain to you the nature of the science and practice of chemistry as preparatory to our observations on mineralogy, we shall now be the better qualified to enter upon that subject.

If we take a hasty view of those inanimate substances of which the globe is composed, we shall naturally be led to attach little importance to their use. A rude mass of earth and stones without any obvious arrangement or capabilities, all thrown together in *apparent* confusion and disorder, is not at first sight calculated to awaken our curiosity, or to impress us with a very dignified opinion of the uses for which they were created. But when we come to examine them more minutely, and to ascertain their qualities—when we practically see the application of most, if not all, of those substances to the arts in general, to medicine, and to the most common wants and conveniences of our nature—and when we examine their actual arrangement upon and below the surface, and associate those appearances with the events of preceding ages in which our future destinies are most nearly connected; we then indeed shall have cause to examine them with an investigating eye, and to endeavour by study and application to render ourselves familiar with the contents of the earth, and with those portions of it which are necessary for our present use, for our ordinary instruction, and what is of still more importance, for our spiritual edification.

The study of this subject, in its more general acceptation, may be denominated mineralogy; but as it branches out into two considerations, namely, to a description of the particular substances of which the earth is composed, and an inquiry into the nature of its structure and arrangement, it has been usual to name the one, mineralogy; and the other, geology.

Mineralogy, therefore, taken in this limited sense, is that science which enters into a particular description of all those inanimate and unorganized substances of which the crust of the globe is composed; as derived from their shape, weight, affinity, colour, taste, smell, feel, and the nature of their external surface, or the appearances they present upon being fractured: secondly, upon the particular situation or scite in which they have been found: and, thirdly, upon a knowledge of their constituent parts, as ascertained by chemical analysis.

Upon this principle, all unorganized substances have been divided into four classes, as forming the basis or primary sources of which the earth is composed—namely, pure earths; salines, including the alkalies and acids; inflammables or combustible substances, and metals: of which, several, according to the late experiments of Sir Humphrey Davy, appear to be compounds; but as this subject is still in its infancy, our illustrations will be better understood, by confining ourselves to the simple arrangement we have now adopted. We therefore beg to observe, that by a varying combination of these substances with each other, or with oxygen (the basis of vital air which forms one of the constituent parts of the atmosphere), most of the mineral substances are formed. These have been divided into species and sub-species, according to the leading article of which they are composed; or to the substance which serves as the medium of union to the constituent parts.

To illustrate these combinations, we may mention that chalk, a substance familiarly known to us all, is composed of the earth lime in its simple state, and of the gas produced from charcoal, denominated carbonic acid gas or fixed air; and from thence it is called the carbonate of lime. Granite, frequently used in architecture, which forms the basis of all the other rocks, and makes up the greatest portion of the highest mountains, consists of a combination of three other primary rocks--quartz, mica, and felspar. Gypsum alabaster, or plaster of Paris, used for a variety of purposes in the arts, is simple lime combined with sulphuric acid; and sulphuric acid is sulphur in combination with oxygen.

Among the saline substances, muriate of soda, or common salt, is composed of soda and of the muriatic acid. Borax, so much used in the arts, consists of soda and the boracic acid; and these acids are compounds, of which oxygen forms a part. Nitre, or saltpetre, is a combination of potash and the nitric acid; sal ammoniac, of the volatile alkali and the muriatic acid; and alum, of alumen and the sulphuric acid.

Among the metals, only a few of which are found in the simple state, a great variety of combinations are to be met with, highly interesting in a chemical sense, and most important to be known in the arts. Iron, the most common and the most useful of all the metals, is found in a state of ore, in combination with sulphur or with oxygen, or it is united to one of the acids. Copper and most of the other metals are to be met with in the same compound state; and in this manner an almost endless variety of substances are produced in the grand laboratory of nature, the greater part of which, from a knowledge of their combinations in some form or other, are applicable to human purposes, and from an acquaintance with their external character and internal structure, admit of easy classification and description.

The utility of the science, therefore, is most obvious; and to obtain a knowledge of it requires memory, application, and a talent for arrangement.

Though there be many practical works on mineralogy which may be recommended to the student, *it is in the field* and *at the laboratory*, and by a habit of comparing the different substances brought under his notice, that a knowledge of it can be most successfully obtained. He must, therefore, himself examine minerals, and note down their external character and their internal properties. He must ascertain the scite upon which they have been found, and their approximation to other substances; he must make many unsuccessful though not useless experiments; and he must learn to class and arrange the substances in their proper places, and to ascertain their chemical properties, before a real insight and solid knowledge can be obtained of the mineral kingdom in all its varieties.

The application of the science to human purposes seems hardly to need illustration. To the artist, the manufacturer, the practical chemist, and the physician, some knowledge of it is indispensable; and to the merchant, it has its use by making him familiar with the properties of those substances which so often form a part of his commercial transactions.

The landholder ought to know his subterranean wealth, that he may turn his property to the best account. The scientific traveller would be deprived of the most useful sources of his inquiry, were he to be ignorant of the various substances which his intercourse with foreign countries might present to his observation; and the well informed person would not be considered accomplished, if unacquainted with the productions of nature, the laws by which they are regulated, and the useful purposes to which they are so uniformly applied.

Iron, gold, silver, copper, lead, and all the metals, the various precious stones, the whole of the earths used in architecture, and of the saline substances as applied to the arts and medicine, are each subservient to the laws of mineralogy; and those laws require to be known to render them useful to mankind. Hence, without an acquaintance with this branch of science, of the improvements of which it is capable, and of the uses to which it may be applied, our insight into the bowels of the earth would be of little avail; we should be deprived of one of the principal means of employment for our numerous population, our attention would be confined principally to the mere gratification of our senses, and the mind would lose one of its most useful excitements.

In a few words, mineralogy and its various applications, form the basis of every thing that is useful and ornamental among human inventions, and the link by which the arts are kept together and rendered subservient to the happiness and conveniences of mankind; and they are the great sources of wealth to, and of intercourse among nations, however remotely situated, or opposed to each other in character, customs, and climate.

Having acquired a knowledge of mineralogy, we shall be the better prepared to enter upon its sister science—*geology*, which illustrates the structure, relative situation, and mode of formation of the different mineral substances in mass that compose the crust of the globe; thus differing from mineralogy, which is confined to a description, classification, and history of each particular substance, without a reference to the general structure.

The study of this subject is, on two accounts, peculiarly interesting. First, as it serves to confirm the Mosaic account of the deluge; secondly, because it teaches us the situation in which, and under what circumstances, particular minerals are to be found. It may be divided into two heads—first, an account of the actual arrangement and relative position of the various rocks of which the mineral kingdom is composed; secondly, an inquiry into the causes by which that arrangement was produced. It is to the former, or the practical part, that we shall confine our present observations, as we have not time to explain the different theories of the earth, which even to this day, agitate and divide the philosophical world.

As far as experience has taught us, the different rocks, which constitute the crust of the globe, may be classed in the following order, subject to certain varieties in particular situations.

The class of rocks, upon which all the others rest, from being considered the most ancient and the least subject to destruction, has been denominated *the primitive rocks.* It consists of granite, gneis, mica slate, hornblende, syenite, porphyry, serpentine, and real marble or primitive limestone. The texture of these is always more or less chrystalline, a quality denoting a previous chemical solution, uninfluenced by mechanical deposition. They are mostly disposed in conformable, unbroken stratifications, each newer stratum with lower level, as is the case with gneis and mica slate; while the granite beneath will sometimes appear to rise up through them, encompassed in various manners by other rocks. In the primitive rocks, no organic remains have ever been found; hence it is supposed they were formed prior to the creation of animals and vegetables. They form the lowest part of the earth's surface with which we are acquainted; and not only constitute the foundation on which the other rocks rest, but in many situations pierce through the incumbent rocks and strata, and form the highest mountains in alpine districts. In the fissures between some of these rocks, veins of metals are occasionally found. From this description of rocks, therefore, we obtain granite, marble, porphyry, and many of the useful metals; and from their solid, chrystalline character, and from containing no animal remains or other deposits, we are taught to consider them the first created substances of nature.

The *second* order of rocks has been denominated *transition* or *secondary*, from its being supposed to have been formed next in order after the primary rocks. This, like the former, consists of chemical productions; but contains also a portion of mechanical depositions, in which the first appearance of fossil remains of animals and vegetables is to be found.

We learn from the organic remains and impressions which these rocks contain, that zoophites and shell fish, which are considered as forming the lowest link in the scale of animal creation, were the first that received the gift of life.

The secondary rocks contain metallic veins in a larger proportion than the primary; and like the rocks above them, water worn pieces of other rocks. They consist of the minerals termed grey wacke, transition or secondary lime stone, transition trap, and transition flinty slate.

Thus this description of rocks, while it supplies us with materials for architecture, and a large proportion of our most useful metals, discovers to us an order of animals the lowest in the link, and therefore supposed to have been the first created, and other depositions, which shew that its formation has been the result of some previous catastrophe.

Over the surface of the secondary is found the flœtz, or flat formations. These rocks are of later origin than the two former, and are of very great distribution, laying over each other in stratifications, and filling up all spaces between the rocks below and those above them. They are considered to be made up of deposits or debris from the other rocks, in combination with organic remains formed at different periods, and by different operations of nature through the agency of water. They appear not to have been produced, like the former, by chemical processes; but derive their origin entirely from mechanical depositions.

In this class of rocks are to be found the fossil remains of the more perfect animals (several at a very considerable elevation above the sea, and others at a great depth from the earth's surface), many of which, from their structure are considered to be antidiluvian; as some are found in parts of the globe where none of the same species now exist; and others are of a species which at the present day are altogether extinct.

These rocks consist of two species of sand stone, two of lime stone, two of gypsum, two of trap, of beds of rock salt of various degrees of thickness, of coal formations, and of the chalk deposits to a very considerable depth and extent; —all of very useful tendency, particularly the articles coal, limestone, rock salt, and chalk. And as it is in this class of rocks that the remains of the more perfect animals are to be met with; where, from the agency of subterranean fire, those conical mountains have been forced up which have been denominated volcanoes; and in which, from a similar operation (as it has been supposed), basaltic rocks of very curious formation and of peculiarly chemical properties have been produced; so this class of rocks cannot but be highly interesting to the geologist and to the philosopher, as well as practically so to every description of persons, to whom the contents of the earth become a matter of consideration.

Over the whole of these rocks, and covering the general surface of the earth, we meet with the last deposit or formation, which, from being produced by the agency of water, has been denominated *alluvial*. It is composed of substances too familiar to us all to need illustration; namely, clay, gravel, sand, loose stones of various kinds, the different species of loams, and in some places of peat moss. Some of these substances in flat situations extend to a considerable depth from the surface; and frequently contain fossil remains of very large animals perfect in all their parts—

some peculiar to the country in which they are found, some only to be met with in the living state in distant parts of the world and under a very opposite climate, and others in which the species is altogether extinct.

It is these alluvial deposits which supply us with some of the principal materials for our buildings, for the formation of our roads, and for many of our useful manufactures, and which furnish the requisite papulum from which vegetation in general derives its support and growth; and it is from these deposits that gold and many of the precious stones are extracted.

Thus the crust of the earth, which encircles the globe, as far as man has been able to penetrate, is made up of four formations, supposed to have been effected at different periods and under different circumstances; each containing materials highly useful, and affording a noble scope for the investigation of the philosopher. These materials, the situation of which can only be acquired by a knowledge of geology, present most incontestible proofs of a previous order of things, which has been perverted by some great revolution or convulsion, that alone can account for the very extraordinary appearances which are so frequently to be met with upon examining the contents of the earth. And whether these phenomena have been produced by the agency of fire according to the doctrine of one set of philosophers, or by water according to that of the other, no doubt can be entertained of the globe having been visited by an universal deluge; or, to use the sublime language of scripture—"all the waters of the great deep were broken up, and the flood gates of heaven were opened;" by which the upper formations of the earth were changed, their materials thrown and mixed together in chaotic confusion; until the waters gradually receding, those materials, with the animals and vegetables previously destroyed by the catastrophe, were finally settled and deposited in the order in which we now find them.

The study of geology is, therefore, of great interest and importance, since it teaches us the particular situations in which all the useful minerals are to be found; it makes us acquainted with the external formation and internal structure of the earth we inhabit; and by examining its contents, it affords us the most satisfactory confirmation of that very extraordinary event, which forms the basis of our eternal expectations, and from which our faith derives one of its principal supports.

The next subject in order of natural history is the vegetable kingdom; the study of which has been denominated—*botany.*

Botany, in the common acceptation of the term, has been confined to a classification and arrangement of vegetable productions from some distinguishing feature in their external formation; and which according to the system of Linnæus, has been derived principally, though not altogether, from the flower; the analysis of which with the stem and leaf, determines the class, order, genus, and variety to which the plant belongs. And as each plant more or less comes under one head or the other, such an arrangement is easily made of the whole as will impress on the memory, by a little practice and attention, the different classes to which nature has subjected the vegetable kingdom; and thus by degrees we become acquainted with each particular vegetable.

But this study, however interesting and instructive in itself, or necessary for the better comprehending the more intricate parts of the vegetable kingdom, is of too limited a tendency to embrace that enlarged view of the subject, which we consider to be important in the study of botany.

It is not the only *external* formation and distinguishing character of plants, or a knowledge of all their varieties, which should become the subject of philosophical interest; but it is more particularly their *internal* structure—the functions and uses of each part—their growth, maturity, decay, and renovation—and the general and particular purposes for which they were created, that confer dignity on the science of botany, and render it one of the most interesting subjects to which our attention can be directed. We *may* indeed admire and dwell upon the beauty and endless variety with which Providence has been pleased to adorn this most interesting part of the creation; and we may find it convenient to set down in our memories the class, order, and species to which each particular plant may belong, so that we may the more readily recognize it when brought under our notice; but it is the economy and laws by which the vegetable kingdom is regulated, and their various operations and corresponding effects, that render the science a matter of deep interest, or entitle it to a place in the school of philososhy.

When we reflect that the acorn, a seed of comparatively small magnitude, contains within its enclosure every part, in miniature, of the mighty oak—its trunk, branches, leaves, bloom, and seed; and that by the simple agency of the soil to which it is applied, aided by caloric or heat, air, and water, all these parts are gradually developed and expanded to the magnitude, order, and beauty in which we so frequently see them;—when we know that the smallest seed, that even requires microscopic aid to bring it under the power of vision, or the most diminutive root by the same process, possesses a similar capability of being rendered a perfect plant of comparatively no trifling dimensions;—when we take into consideration that each plant has vessels, absorbents, and respiratory organs, by which a circulation is kept up, secretions are effected, superfluous parts removed, and atmospherical air absorbed and expired as it may suit the growth of the plant, or answer some general purpose in the economy of nature;—when we find that plants, like animals, possess life and are liable to accidents by which the vital principle may be destroyed, as well as the means of perpetuation to almost an indefinite degree;—and when our every day's observation inform us of the comprehensive uses to which the vegetable kingdom is applied, whether for the support, conveniences, or luxuries of man, for the subsistence and continuance of other animals, or to contribute to the general benefit of the globe which we inhabit, we shall then indeed have a wild field for contemplation and enquiry: our minds will at once be awakened to the importance of the subject, and we shall enter upon it with that deep interest and zeal, those high feelings of reverence and admiration, and that anxious curiosity to examine the works of the creation, which so noble a theme is calculated to inspire.

To describe the structure of plants, the uses of each particular part, and the means which nature employs to promote their growth, maturity, decay, and renovation, belongs to the province of physiology, which it was my most anxious wish to have entered upon, as being a subject highly delightful and instructive; and with this I proposed to have taken a particular view of the classification of the vegetable kingdom according to the system of Linnæus, and which in the familiar acceptation of the term, has been denominated botany. But this, considering the advanced hour at which we are arrived, I must leave to some other occasion; and briefly observe, that the vegetable kingdom, of which an *enlarged* botany (for we do not confine our meaning of that term to a mere classification and nomenclature of plants,) may be considered the history, if taken in all its comprehensiveness and capabilities, is one of the most important and useful subjects, to which the human mind can be directed. For without the vegetable world, how should we obtain our food and our clothing, both of which directly or indirectly depend upon the supplies which vegetation affords? Or what would become of our agriculture and our commerce, our architecture, and all those very numerous arts, which, while they afford employment to our population, contribute to those wants and conveniences, not to say luxuries, which in the present state of society have been rendered so necessary; or how should we supply the place of many of those valuable remedies, which in the hour of sickness preserve our lives, or at least serve to mitigate our bodily sufferings, if deprived of this most comprehensive resource?

Without vegetation the face of nature would lose one of its principle beauties; and the earth, thus exposed to the operation of the conflicting elements, would soon become chaotic and unfit for the habitation of man. The sea, now the grand source of intercourse between nations, would no longer be navigable; for without ships, whose materials are chiefly derived from the vegetable kingdom, how could its surface be traversed? or without boats and nets, by what means could we obtain that main article of our food with which its waters now so amply supply us, so important to our wants, and so useful in the various occupations to which it gives rise? Or without vegetable absorption and assimiliation, how would the earth dispose of the superfluous water produced by *marine* evaporation, at present so fertilizing to the soil, and so contributive to the wants and conveniences of man? From what source would the atmosphere, constantly exposed to deterioration by combustion and animal respiration, be renovated, without those vegetable exhalations, through the agency of which its purity is now preserved? Or, if the whole animal kingdom were to become carnivorous only, which must be the case under such a visitation, how long would man preserve his existence, or retain his controul over the creation, even if an impure atmosphere permitted him to breathe, or his constitution could long survive the total loss of a vegetable diet?

Thus in the present state of things, the vegetable world takes the most important part in the economy of nature. For it is not only the chief ornament and support of the globe we inhabit; but, from its renovating influence on the atmosphere, and from the subsistence it affords, it is the great source of life and perpetuation to the animal kingdom. It forms the basis of agriculture, of most of the arts, of navigation, and of general commerce; and through those various channels, it gives an impulse to human industry, from which alone most of the prosperity and blessings we enjoy have emanated. And if to these considerations, we add its localizing tendency, and the domestic habits which result, so essential to civilization and personal happiness; we shall at once comprehend the importance of the subject, and how much it becomes our duty to study its laws in all their various applications, whether as a matter of philosophical inquiry, or practically considered, as contributing to those wants and conveniences of which, in our present imperfect condition, we so essentially stand in need.

After this cursory view of botany, we must now pass over to the animal kingdom, the last subject of natural history for consideration; the science of which has been denominated *zoology*.

The study of *zoology* branches out into so many important divisions, that I regret it will not be in my power to do more in this advanced stage of my lecture, than to impress on your minds the advantage of making it one of your earliest pursuits.

In the vegetable kingdom we see an almost indefinite variety of substances, each possessing its own peculiarities and beauties, endowed with organs necessary to its vitality, growth and perpetuation; clothing and adorning the face of nature, and affording subsistence to a large proportion of another very important part of the creation.

We observe these substances constantly assuming new appearances, until they have passed through the differeut states requisite to complete their destiny; and we can ascertain that they possess the life and the irritability peculiar to other animate substances. But here their attributes cease. They posesses no power of locomotion, but live and die on the spot in which they are placed.

Endowed only with the common principles of vitality, as far as we can judge, they neither feel when excitants are applied to them, or are conscious of their existence; but pass through the circle of life, death, and renovation in mechanical order and uniformity.

In the *animal* kingdom, with an endless diversity of appearances, circumstances, and movements, to fix our attention, or to awaken our curiosity very far beyond what the vegetable world (however wonderful in itself) is calculated to produce; we see the vital principle called into action upon the most comprehensive scale, giving energy and effect to an immense variety of operations, simple and compound, to answer the diversified purposes for which this most interesting portion of nature was created.

Thus, with the common laws of vitality peculiar to vegetables, animals possess the power of locomotion, or moving from place to place to an indefinite degree and *the will* to produce it.—They can see, hear, feel, smell, taste, know their own species, and form their attachments and dislikes; see the approach of danger, and know how to avoid it; are capable of enjoyment, and are tenacious of the life by which all these actions are produced.

All these may be considered properties common to most animals, and of themselves afford a noble field for the physiologist, as well as for the man of taste, or of more ordinary inquiry.

But when we examine the *intellectual* powers of different animals,—the sagacity of the one, and the contrivance of the other; when we investigate the laws by which each class in all its varieties, from the most diminutive to those of the greatest magnitude, is regulated; and the different movements and effects to which those laws give rise, to answer their own particular purpose, or to be rendered subservient to some still greater end; and when we advance in the scale, and inquire into the *human* attributes, and into the diversities and comprehensiveness, in all their ends and purposes for which *our own* species was created; we shall then indeed find a theme worthy of our pursuit and inquiry; we shall at once comprehend the object of creation, and we shall irresistibly be impressed with those sentiments of reverence and devotion, which a just and enlarged contemplation of the natural world, cannot fail to inspire.

Having endeavoured to explain to you the different branches of natural history with their corresponding sciences, permit me again to impress on your minds the importance of a subject so closely connected with every thing that is dignified and useful, and so interwoven with the wants, conveniences, and occupations of man. Had it been our lot to have moved in the limited sphere of *other* animals, and our wants and necessities been supplied us as nature required them, we then indeed, had we even possessed a consciousness of our existence, might have been satisfied with the ignorance which a situation so humiliating was calculated to perpetuate. But man was born for a life of activity and observation, to a dependance upon his own faculties and industry, and to be placed in situations in which the best powers of his mind were to be called forth, before he should participate in all those gratifications, sensual and refined, which in the natural world have been prepared for his especial accommodation. Providence, therefore, has wisely ordained that he should commence his career in ignorance and helplessness; and that it should be only by the slow march of time and experience that he should become acquainted with those powers which qualify him to partake of, and to command the best gifts of nature.

To prepare him for the task, curiosity is nearly the first propensity which is developed in his *infant* mind. Every object, and those of nature more frequently than any other, upon the first dawn of observation, awaken in him a desire to know their names and properties; and thus from the cradle he more or less becomes acquainted with created substances, and the common appearances of nature. From learning first their external character, he gradually finds out some use to which they can be applied; and his inventive faculties being ultimately called into action, he is furnished with a variety of occupations and pursuits that give a new turn to his ideas and character, such as in the earlier part of his life he had never contemplated.

Thus with natural history as a basis, are produced the arts and sciences in all their comprehensiveness and varieties, and every thing that is useful, ornamental, and honourable to man; and thus the human mind is gradually exercised, enlarged and edified, until all the reasoning powers are called into their fullest activity, through the agency of which we are prepared for the higher destinies which await us.

Under such auspices, it becomes our duty, not only to endeavour to make ourselves acquainted with the subjects of natural history at whatever period of life we may have arrived, but to lose no opportunity of impressing on the *infant* mind (always prone to acquire a knowledge of such things as are presented to it) those branches of the subject best suited to its capacity, and to explain in the most intelligible language their uses and purpose; to encourage it by every means in its inquiries; and never to suppress a curiosity, implanted by nature for the wisest of purposes, under the erroneous impression that it originates in frivolity, or a desire to be intrusive or troublesome.

Thus by degrees, a knowledge of all the different substances of the creation, and the appearances of nature, will be acquired, and receive a lasting impression; and the mind, having once taken an active direction, industry, invention, reflection, investigation, and reasoning upon causes, will succeed each other in regular order, and ultimately produce the highest intellectual acquirements, (however *comparatively* imperfect they may be,) to which the human mind can aspire.

Such is the study of natural history in its practical applications.

Taken in a moral sense, it is calculated more than any other subject to occupy and enlarge our minds, and to correct our prejudices; to render us humane and benevolent, and to promote the best virtues of our nature.

In its religious operation, it affords us proofs, the most convincing, of the omnipotence of the Creator, and of our own divine origin. It teaches us, by admonitions which we *cannot* mistake, the important duties we have to perform, and by examples daily before our eyes, the mortality to which we are liable. While *from analogy,* as well as from our own internal conviction, it holds out to us a reasonable hope, that as, by the unerring law of nature, all organized bodies are doomed to decay; so we shall in due time be restored, and in the full comprehensiveness of the Deity, partake of those divine attributes, of which in the limited sphere we now move, we at present possess little more than the shadow.

LECTURE II.

ON VEGETABLE PHYSIOLOGY.

AT the opening of the season, I had the honour of reading to you an introductory paper on natural history and the sciences; in which I endeavoured, by concise illustrations, to impress on your minds the advantages of studying those subjects, and more especially such of them as had an immediate reference to the objects of our institution. Among these, the laws of the vegetable kingdom were made to hold an important place; but as, from the limitation under which I then laboured, I could only take a cursory view of the subject, I propose to avail myself of this opportunity of entering more largely into its nature and import.

When treating on any particular science, it is usual to notice its origin and history. Upon the present occasion, confined as I am to a single lecture, such a measure becomes impracticable; and it is of the less importance, since you will find the subject amply explained in most of the systematic works on botany, and which will form a part of your reading, should your attention be more particularly directed to its study.

By a vegetable, we mean an organized substance possessing vitality, power of growth and re-production, deriving its nourishment directly from the earth, or from substances in which earthy matter is more or less present, but without perceptive powers, or voluntary locomotion; the two latter properties belonging exclusively to animals, and forming the principal line of distinction.

Hence every living substance of the above description, whether it be a tree, a shrub, a herb, a grass, or a flower, is in reality a vegetable; and the whole, taken together, constitutes what has been termed the vegetable kingdom.—Of these, nearly one hundred thousand species, each possessing its own peculiarities, form and laws, have already been discovered, and the list is annually increasing. The subject therefore, independently of its practical application, is one of deep interest and importance; and the more it be examined, the greater field we find for enquiry, and an increased reason for admiring the contrivance, wisdom, and benevolence, by which this interesting portion of the universe has been regulated.

To describe each particular organ of a vegetable, is denominated *the anatomy*, and to enter upon the functions of those organs with the results, *the physiology* of vegetables. To explain their component or constituent parts, belongs to the province of *vegetable chemistry*. To treat on the sources by which their growth is promoted, and their productions increased, comes under the head of *chemical agriculture*, or *agricultural chemistry*. And to class and arrange them, according to their external character, so as to distinguish the one from the other, in the common acceptation of the term, has been termed *botany*; though botany, in the strictest sense, applies to a history of the science, in all its different relations.

Had it been in my power to have delivered a full course of readings on the laws of the vegetable kingdom, I should have considered it my duty to have devoted one lecture at least to each of the above branches, and to have detailed all the minuter parts requisite for their special illustration. Upon the present occasion, for the reasons obviously assigned, I must limit myself to a very brief account of the structure and physiology of vegetables.

From the great similarity and strong analogy of the laws of the vegetable and animal kingdoms, many modern philosophers have considered the vegetable and animal kingdoms united by one link, and forming a part of the same system; or, in other words, that a vegetable is only an inferior order of animal. But admitting how nearly in many instances the laws of each approximate, and how greatly a knowledge of the one facilitates that of the other; yet the more frequent presence of perceptive powers, and more especially of a choice and capacity of motion in the one kingdom, and a total absence of those qualities in the other, present so broad and strong a line of distinction, as should make us pause before we admit a doctrine directly at variance with our common observation, and so opposed to the idea we have entertained of the intents and purposes of the creation. All that we ought to allow, is that resemblance only in the physical properties and laws of the two kingdoms, by which the vitality peculiar to each is preserved, the different parts are nourished, growth promoted, secretions produced, re-productions effected, and the common principles of decay and dissolution are brought into action. But *here* their analogy ceases.

Vegetables, we know, require a particular temperature, season, soil and aspect, for their growth and maturity, and, in many instances, even for their very existence. In cold climates, they are, in consequence, proportionally limited in the number of their species; and, in the winter, even of temperate regions, many of their functions are suspended; they cease to grow, they part with one of their most essential organs, their leaves; and they require the return of a more congenial season, before their variously animating powers are again roused into action.—Animals, on the contrary, so long as the vital principle be continued, preserve their various functions in full activity and similitude, in whatever temperature, season, soil, or aspect, they may be placed; and a loss of any one of their important organs, or a considerable interruption to the functions of the others, very frequently terminates in their general dissolution.

Vegetables, again, have not, as we before intimated, a brain and nervous system to endow them with perceptive powers, or, as far as we can judge, with sensation; nor muscles to promote their locomotion, so necessary to most animals which are to make choice of their own food, and whose means of supply are not confined to a narrow circle as in vegetables, in which nature by their peculiar mechanism, has bestowed on them the means of obtaining their nourishment from the soil which first gave them birth. For this purpose the latter are permanently fixed to one spot in the earth, and the vital spark having once been excited, their different movements are rendered dependent upon principles, in which the will has no concern, and where perception cannot be required.

These reflections necessarily lead us to a consideration of the structure and functions of vegetables, in which the analogy of the two kingdoms will be further illustrated, and of the line of distinction, we hope, satisfactorily explained.

To consider vegetable physiology in all its relative bearings, it will be requisite to divide the subject into three distinct heads. Firstly, the structure and functions of those parts of a vegetable which contribute to its nourishment and preservation, including the root, trunk, branches, and leaves. Secondly, of those organs which are necessary to its re-production, and these have reference to the flower, fruit, and seed. And lastly, the process of re-production, embracing the structure of the seed, its germination, and the formation and completion of a new plant.

But previously to entering into a particular explanation of the several organs, it will be proper to inform you that the *general* structure of vegetables consists *originally* of only *two parts, the fibrous portion* and the *cellular tissue:* all the other materials are derived from extraneous sources, and therefore are not considered as belonging to their structure. It is the arrangement and modification of the above two substances, which alone constitute the difference in the formation of each part of the plant.

The *fibrous portion,* it has been ascertained, consists of linear and spiral tubes, or vessels, which, in vast numbers take various directions through every part of the plant, and form the channels of circulation for its respective fluids.— So long as these vessels remain pervious, they continue tubular; but when trees become large from age, by the constant pressure of the surrounding parts many of these fibres lose their vascular character, and form what has been termed the heart or dead wood.

The cellular tissue is made up of a fine transparent membranous substance, which, crossing itself in different directions, forms cells, hexagonal or circular, according to the part of the plant. Into these cells the tubes empty their fluid contents for future elaboration. The two parts, therefore, the fibrous portion and the cellular tissue, frequently come into contact, and by running into each other in most instances form a portion of the same mass; though, for the sake of illustration, we shall consider them as holding a distinct place in the plant. We shall now proceed to the root, the first organ to be described.

The root, which, though often differing in its bulk and shape, is similar in all in its structure and use (with the exception of the bulb, which, from containing the rudiments of a new individual may more properly be considered a variety of the seed,) is that part of the vegetable which fixes the plant to the ground, is its organ of nourishment, and the apparatus by which, through its various ramifications below the surface, it imbibes food from the soil.

In its structure, it is composed of the same parts as the stem and branches, and therefore may only be considered as the stem inverted; the lower portion of the tube dipping into the earth, and forming itself into minute ramifications without leaves; and the upper portion ascending, and producing buds, branches and leaves. This has been illustrated by experiments made upon the plum, cherry and willow, in which, by inverting the stem and root, the former has become a root, sending out ramifications, and the latter a stem producing leaves, flowers and fruit. The structure of the root and stem is therefore one and the same thing, and it is the situation in which each is placed, and the operation of the surrounding medium, that make the difference; giving to each, a variation in its chemical and medicinal properties though their physical structure continue the same.

The main body of the root, which has been termed *the caudex*, upon its first penetrating the ground, possesses but very limited powers of affording nourishment; and it is not until it has sent forth its ramifications or *radiculæ*, and these ramifications have issued still finer filaments of capillary diameter, that an extensive absorption can be effected. These minute tubes, by dipping into the soil in the direction where there is the least opposition, abstract from it, by some undiscovered process, those nutritive parts, which, through the agency of water, become a fluid termed the sap, and convey it to the caudex; from whence it rapidly ascends to the stem and branches, and thence to the uttermost extremity of the leaves, there to undergo a new modification to be hereafter explained. The root therefore may be considered as acting the same part towards the vegetable as the stomach does to the animal; though the apparatus and the fluid prepared, bear no similarity.

That part of the plant which ascends from the caudex of the root in a vertical direction into the air, has been denominated *the stem or trunk*, and its structure is very particularly deserving of your notice. It consists of an external and internal bark both of very singular mechanism, of two species of wood, and of an internal substance denominated the pith.

The external bark, which has received the different appellations of the *epidermis*, *cuticle*, *false skin*, *and the like*, admits of easy separation, and is the envelope or outward integument of the plant, extending like the upper skin of animals over its whole surface, so as to completely invest the root, stem, branches, leaves, the flowers (with the exception of the stamen and pistil) and the fruit. In the root and trunk, it is a tough and leathery membrane; while in the leaves, flowers, and tender shoots, it is a fine colourless and transparent film, often as thin as a cobweb. When examined by the microscope, it seems to be composed of a number of slender fibres of membranous texture, crossing each other, so as to form a kind of net work, having externally the appearance of laminæ or scales, which, in old trees, may be seen in a loose and decaying state. In others less advanced, it is often so compact as to resemble a solid mass; while in delicate shoots, it presents, as we have before stated, a fine membranous texture.

The vegetable epidermis, which like that of animals, consists only of condensed cellular membrane, is not vascular, though, as in animals, it is endowed in every part with very minute pores, and with terminating ducts to admit the absorption of the atmosphere, and the transpiration of the superfluous fluid of the plant; while, like the shells of crustaceous fish, it defends the interior parts from injury. In the larger trees and shrubs the bodies of which in themselves are strong and of firm texture, the latter property is not of so much importance; but in the reeds, the grasses, the canes with hollow stalks, and in the various farinaceous seeds, where it is most essential that their structure should be protected from the action of insects; nature, to render it more strong and resisting, has given it a glassy kind of net work, composed principally of a silicious earth, which Sir Humphrey Davy has ascertained in many instances, is capable of striking fire upon the application of the steel.

Immediately below the epidermis is *the cutis, real skin, or true bark,* consisting of two parts—

the *cellular tissue*, and the *cortical vessels.* The former, or cellular tissue, consists of a soft substance formed into cells like the honey-comb of bees, and filled most frequently with a green, though sometimes with a brown, red, or yellow fluid; the whole being arranged with the most perfect symmetry. This interesting part of the bark is not only essential to the stem and branches, but it forms also a most important portion of the organism of the leaves, flowers, fruit and roots; and is the instrument by which the returning sap is elaborated and converted into nourishment, and into the various secretions peculiar to the plant.

Below the cellular tissue, though often blended with it, and immediately above the wood, are situated the cortical vessels, by some naturalists, from their resemblance to the leaf of a book, denominated the liber, by others, the interior portion of the true bark. They consist of a number of layers, the outer stratum of which is coarse and loose in its texture, forming a very irregular kind of net work, while the inner layers are soft, smooth, and flexible; both being combined with longitudinal vessels which separate and approach each other alternately.

The cortical vessels, with the cellular tissue, take a very important lead in the economy of the plant; since the former are destined to receive the returning sap from the leaf, and to convey it into the cells of the latter; in which, as we have stated, the nutritive and other juices, necessary to the growth and preservation of the plant, are elaborated and deposited in their respective receptacles, but whether by glandular strainers or by other agents, experience has not yet decided. We have here another analogy that exists between animal and vegetable nutrition, as far as the effect and object be concerned; though the instruments employed, and the secretions produced, will not admit of a comparison.

Immediately under the cortical vessels, we find *the wood,* composed of an external vascular substance, which, from being white, has been termed *the alburnum,* and in old trees, of an internal unorganized part denominated *the heart or dead wood;* the whole surrounding a tube in which is situated *the pith;* the wood representing to the eye externally, an arrangement of concentric and divergent layers. The concentric or circular lines shew the layer of new wood which has been formed by the cortical vessels each year; and from the number of these, the age of the tree is usually ascertained. The divergent lines, which from their white appearance, have been denominated the silver grain, do not admit of so easy an explanation.

The *alburnum,* or *sap wood,* which may be considered the grand vascular organ of the plant, is made up of cells and tubular vessels; the cells being constantly filled with the rising sap, which, after undergoing some changes, is taken up by the tubes and conveyed to the leaves to their utmost extremity; and having from them received a new modification, the sap is returned by the cortical vessels (as have been previously explained) back to the trunk, and thence to the minutest filaments of the roots.

The *heart wood*, which, when present, is seated below the alburnum, seems principally intended, (like the bones of animals,) to give solidity, form, and support to the more solid parts of the plant, and is mostly observable in old trees.

The *pith* is a soft and spongy, but often succulent substance, occupying the centre of the root, stem and branches, and extending in the direction of their longitudinal axis, in which it is inclosed as in a tube. In its structure it is exactly similiar to that of the cellular tissue of the bark; being composed of an assemblage of cells containing a watery and colourless fluid. In the first infancy of the plant, the pith occupies but a small space; it afterwards gradually dilates, and in young trees offers a considerable diameter. In those more advanced, pressed and acted upon by the heart wood, it begins to diminish; and in very old forest trees it disappears altogether. Having ascertained that a portion of it may be abstracted without injury to the plant, naturalists consider the pith only of secondary importance;

though they allow its use in making good the nutritive exhaustion which the rapid growth of young shoots never fails to produce.

From the stem or trunk, progressively emanate the several branches of the tree or plant; the structure of which corresponding exactly with that of the stem, we shall proceed to *the leaves* which hold so important a place in the economy of vegetation.

This part of the plant, which contributes so much to its beauty (though infinitely diversified in its forms), is in all cases similar in its organization as well as in its functions. It consists of a thin and flat substance usually of a green colour, issuing generally from the extremity of the branches, though sometimes from the stem; and is to be distinguished by the sight or touch, into an upper and under surface, a base, a midriff or centre line of division, and into lateral lines, or, as they have been improperly termed, lateral nerves.

In its structure, the leaf is made up of a continuation of the cellular tissue, which forms its principal bulk, of a distribution of the alburnum or sap wood, of a small portion of the heart wood and of the upper extremities only of the cortical vessels; all of a peculiarly minute and fine texture, forming a delicate net work; the whole being very thinly covered over by the epidermis, the size of the leaf varying, from the smallest proportion that can be distinguished by the naked eye, to a magnitude that almost exceeds belief—namely, to several feet in diameter.

The functions of this very interesting organ may be considered the most important of any which are connected with the preservation of the plant. To illustrate these, it is to be recollected that the nutritive ingredients, when first absorbed, are only in their simple state, held in solution by a considerable proportion of a watery fluid; and require the aid of a further process before they possess the consistency and the chemical properties requisite to produce the various secretions which are to contribute to the nourishment and preservation of the plant. The agent, to effect these important changes, are the leaves; and the process, by which those changes are accomplished, is, in the first place, by evaporating a considerable proportion of the watery part of the simple sap as it is conducted from the roots, by which its fluidity is diminished; and, in the next, by absorbing, or taken up from the atmosphere, a certain proportion of its oxygen, caloric, light, and of various nutritive materials, held in solution in that element; by which, through chemical agency, new principles are communicated to the fluid, now denominated, *the proper juice or true sap*, previously to its descent, to supply the different parts of the plant with renovating secretions.

To promote this object, the surface of the leaf is rendered broad and extensive, the tubes and cells exquisitely fine and delicate, their texture throughout, porous and transparent, and the orifices of the epidermis (so essential to the process,) numerous beyond calculation, and so extremely minute, as to require very powerfully magnifying glasses to detect them; their diameter being only adapted to the absorption and extrication of vapory fluids in the highest degree of tenuity.

The processes of transpiration and absorption, as peculiar to the functions of the leaves, are indeed of a most highly interesting character, and require a far more able pen than mine to do justice to their illustration. Upon the new or ascending sap reaching the leaves from the roots, the operation of transpiring a portion of its watery particles commences from the smooth or upper surface of the leaf as soon as the sun rises, and continues until the approach of night; by which the sap acquires more consistency and is thus rendered fit to receive those materials, which are to be imparted to it through the agency of absorption. This evaporation is so considerable, that Dr. Hales, whose experimental accuracy has never been questioned, has ascertained, that a cabbage transmitted daily more than half its weight, and that a sunflower, three feet high, transmitted in twenty-four hours, a watery fluid equal to twenty ounces.

While this watery evaporation is going on, an absorption by the same surface of the leaf of the carbonic acid gas of the atmosphere, and a decomposition of some of the water left in the sap, are taking place; by which, in the former instance, the carbon is separated and fixed in the sap, and the oxygen gas is set at liberty; while in the latter, the hydrogen is communicated to the sap, and its oxygen gas also becomes free; by which operations, the sap has acquired two of the leading principles necessary to vegetables, the carbon and the hydrogen; while a double supply of oxygen, or the vivifying principle, is restored to the atmosphere, by which its purity is preserved against the deterioration to which it is uniformly exposed by animal respiration, combustion, and mineral absorption.

During the night, the *under* surface of the leaf absorbs moisture from the air, or from the evening dew, to make up in some degree the deficiency of the previous day's evaporation, and takes up oxygen from the atmosphere, by decomposing it and setting part of the nitrogen at liberty: a portion of the oxygen thus absorbed, is fixed in the sap, and the other part, uniting with the superfluous carbon in the plant, forms carbonic acid gas, which escapes from the leaf and mixes with the atmosphere. This will serve to explain, why the night air is less salubrious than that of the day; and the necessity of a large proportion of oxygen being set at liberty during the day, to obviate the injury which the atmosphere sustains by the operations of the night.

Thus we have seen that the leaves of plants perform very different operations at different times; since during the day, they are giving out moisture, absorbing carbonic acid gas, and emitting oxygen gas; during the night, they are absorbing moisture, giving out carbonic acid and nitrogen gases, and taking up oxygen gas. By these operations assisted by the agency of light, (which, independently of its imparting colour to the leaf, contributes essentially to its chemical changes,) the sap receives all the primary principles which constitute the plant—namely, oxygen, hydrogen, carbon and nitrogen; by the various combinations of which, nourishment to the plant is not only produced, but also through the agency of secretion, those other substances are elaborated which we know can be extracted from vegetables; and which, taken from one description of vegetable or another, amount to no less than thirty-one articles, exclusively of those which, belonging to the mineral kingdom, have been denominated extraneous; while, by a very beautiful process, the purity of the atmosphere is so balanced within the twenty-four hours, as to be fitted for all the purposes of animal and vegetable economy. Thus by a wonderful piece of mechanism that cannot be too much admired and investigated, and in the construction of which there is still a wide field for discovery, the sap in its simple state is absorbed from the earth by the roots, and conveyed through the cells and the tubes of the wood into the leaves; where, by the processes of evaporation and absorption (as just explained,) it acquires new principles and becomes the true sap. It is then taken up by the extreme vessels of the bark, and by them conveyed back to the branches, stem, and root; depositing in its passages through the cortical vessels into the cavities of the cellular tissue for elaboration, such portions of it as are to be applied to the purposes of nutrition, or to those secretions that are necessary for the preservation of the plant.

The functions of the leaves have been compared to the respiration of animals, by which the blood parts with its superfluous water, and acquires new principles from the atmosphere; and hence the leaves have been denominated the lungs of the plant. But in this, as in every other instance, a strong line of distinction may be drawn. The change in the leaf is simply effected by exudation and absorption, both of which are varied according to the existing temperature and the time of the day. *That* in the lungs is accomplished by muscular action, and is uniformly the same at all periods, and under every atmospherical change. Animal respiration destroys the purity of the atmosphere. Vegetation restores it; the deterioration of the night being amply balanced by the renovating operations of the day. In the winter, when foliation is suspended, the absence of vegetation is supplied by the agitating storms of the season, bringing with them purifying breezes from the ocean; or rendering less stationary the deleterious exhalations of the land.

Thus in the natural as in the moral world, occurrences, which individually appear to be very striking evils, collectively are productive of the greatest degree of good; and the functions of organic substances, which from their primary effects carry with them strong features of similarity, when more closely investigated, are found to be productive of very opposite consequences.

Before we quit the physiology of leaves (though irrelevant to the subject we have just been treating,) it will be proper to mention, that particular plants and flowers in general close their foliage during the night; and this has been *erroneously* termed the sleep of plants. Sleep, as applied to the animal kingdom, more especially the human subject, we know, consists of a suspension of most of the active functions to afford repose to the body, more or less exhausted by the exertions, mental and corporeal, of the preceding day. In plants, deprived as they are of all power of locomotion, and exposed to no mental excitements, none of the exhausting causes which operate upon animals prevail, and therefore they seem to need no repose; and if requisite, a large proportion of their species are without its benefits, since a great many of them never close their leaves excepting when they approach to decay. A more probable cause of this phenomenon will be found in the provision which nature has made to guard the more tender plants and the flowers (always delicate) against the operation of cold; so that when the usual excitements of light and heat are withdrawn, they close their leaves as a necessary precaution.*

Having finished our account of the nutritive agents of plants, we are next led to consider the organs employed by nature for their re-production; and these, as we have before stated, consist of the flower, fruit and seed.

It is well understood, that upon the early advance of vegetation, there are to be seen sometimes upon the stem, frequently upon many of the bulbous roots, and always upon the branches, very small prominences denominated the gem or bud, containing the rudiments of future formations; some expanding into leaves and new branches, some into flowers, and some into flowers and leaves conjointly.

The flower gem, to which our attention now must be exclusively directed, by the progress of vegetation, gradually expands and enlarges until

* Upon this subject, however, very different explanations have been given by naturalists.

the outline of the flower becomes observable; when supported by the stalk or peduncle, all the several parts are progressively developed, until the flower itself bursts forth in full maturity and beauty.

In no part of the vegetable creation has so much taste and variety been displayed as in the flower; the brilliancy, shape, and fragrancy of whose blossoms cannot fail to attract the attention of the most indifferent observer; while the whole face of nature is adorned and enlivened by the diversity of their species, and the endless variety of their tints and hues. But it is not the taste displayed in the color, form, and distribution of the flower (however fit objects for admiration), that confers the greatest interest upon these organs of vegetables. It is their internal structure and the object they have to answer, which entitle them to philosophical consideration.

The flower is composed of the calyx or cup, of the corolla or blossom with its petals, of the receptacle or base, and of the nectarium, *as auxiliary;* and of the stamens with their anthera, and the pistil with its stigma style and ovary or germ, as *primary or essential organs* of fructification.

The calyx, which is to be found immediately surrounding the lowest portion of the corolla or blossom, is a green membraneous sac, most frequently formed into the shape of a cup, and is intended to defend, support, and nourish the more perfect parts within. It is consequently made of stronger materials, that it may thus perform its functions uninterruptedly.

The corolla or *blossom*, in which all the beauty of the flower is invested, is supposed to be an extension of the inner or vascular part of the bark; and consists either of a single piece, or most frequently of many pieces that have been denominated *petal* or *petals*; and these are found to contain an infinite variety of small tubes of the porous kind, intended (as it is conjectured) for the absorption from the atmosphere and from the rays of light, of those renovating materials which are to contribute to the support and fertility of the more essential parts of the flower; while the corolla generally, defends and protects those parts from external injury. The mechanism of the petals therefore is of a very delicate and minute character; and the corolla, by encircling the internal parts with its foliage, is well calculated to answer the defensive purposes to which we have alluded.

The receptacle is the base of the flower close to the stalk upon which all the other parts rest, as may be seen in the artichoke, when the leaves are removed; and which, no doubt, though we may not comprehend it, serves some other useful purpose in the economy of vegetation, independently of the support it affords to the flower.

The nectarium, or *nectary*, consists of a small sac or bag, situated most frequently, (though not uniformly) at the base of each petal, from which the honey is secreted that is supposed to be the source of nourishment to the internal parts of the flower. When the nectarium is wanting, nature has given greater activity to the other nutritive organs; and when in the place of honey, a strong poisonous fluid is secreted, (as is sometimes the case) it is intended to keep off and destroy insects in those flowers which are particularly liable to their attacks.

Having described the contributive, secondary, or auxiliary parts of fructification, we come now to the essential; and these, as we have previously stated, are the stamens and pistils.

The stamens which are formed of the woody part of the plant, are slender thread-like substances, varying in number in different flowers, and placed within the corolla, and on the outside of the pistil which they surround. On the top, or upper extremity, is situated the anther; a small prominent bag, or viscus, which contains in cells, or rather in globules, the pollen, farina, or dust, (most frequently of a white, though sometimes of a yellow, orange, or of a violet color,) that forms the great principle of fertilization, and therefore is deserving of particular attention. From the anther descends a fine line of communication called the filament, which attaches the stamen to the receptacle, though sometimes to another part of the flower, according to the varying circumstances of each individual.

The pistil, which is formed of the pith of the plant, is a small and column-shaped substance, occupying almost invariably the centre of the flower, where it is encompassed immediately by the stamens. It varies in number, being sometimes one, as in the cherry; and sometimes more than one, as in the apple and pear. It consists of at least two, but more generally of three distinct parts; the ovary—the style—and the stigma, or summit.

The ovary is situated at its lower extremity or base, supporting the style and stigma, and from containing the rudiments of a new plant, has been denominated by Linnæus, the germ, or germen. In its figure and shape, it varies in different plants; consisting in some of only one cell, and in others of more, according to the peculiarity of each individual flower.

The style, which is the middle portion of the pistil, is a prolongation of the substance of the ovary, being terminated at its upper extremity by the summit or stigma, thus forming a line of communication between the two extreme parts.

The stigma is a small glandular looking substance, sometimes of a triangular, at other times, of a circular shape, placed at the top of the style, and from which it is also denominated, the summit of the pistil; as the style may be termed the centre, and the ovary or germ, the base.

It is upon the arrangement of the stamens and pistils, that Linnæus has principally formed his system of classification; the particulars of which our time will not permit us to illustrate upon the present occasion. It will sufficient to observe, that the pistil (at its base) is the organ which contains the rudiments of the fruit and future seed; but which seldom acquires a re-productive property, without the influence of the dust contained in the anther of the stamen; and which being dropped, by the bursting of the globules, on the stigma, invests the ovary with the requisite fertilizing principle.

The contents of the ovary being thus called into action, it gradually expands and enlarges, until by its own natural supplies, it is rendered independent of the other parts of the flower; and these being no longer required, they decay and drop off, and the fruit or pericarp by a progressive increase, is ultimately formed into all its magnitude and perfection. Thus we see the ovary, which, in the early stage of growth, exhibited only the appearance of a homogeneous mass of pulpy substance, as it advances in size, displays the rude outline of separate organs, until it reaches its full magnitude; when the embryo of a future plant may be discovered in the centre of its own supplies. By this process the pericarp, in a diversity of shapes and forms, is rendered perfect in all its several parts; and as the seed, which it contains, is one of nature's greatest resources in the vegetable world, it is defended above all other parts of the plants against the accidents to which it may be liable. Thus in the one instance, it is imbedded in the soft pulpy substance of the esculent fruits; in another, it is protected by thick membranes, and inclosed in a pod, as in leguminous vegetables; while in a third, it is surrounded by a hard shell or a thick cuticle (as in the various species of corn), which requires a very strong force to rend it asunder. It is thus fitted for the purpose of future germination—the next subject for discussion. But we must previously claim your indulgent attention to a few observations, which a retrospect of the preceding subject has naturally suggested.

In no part of the vegetable kingdom has nature displayed more ingenuity or greater protecting care than in the instruments of re-production, so necessary to the perpetuation of the species. Thus the ovary, which, from containing the rudiments of a future plant, is her principal object, is placed completely at the base of the centre of the flower, supported perpendicularly by the upper portion of the pistil, as the point of greatest security; and being surrounded by a double wall of defence—first, by the circular arrangement of the stamens, and secondly, by the petals of the corolla, it is completely shut out from all injury, without excluding the light and air so necessary to its existence.

The stamens, from which the fertilizing principle is to be derived, are secured within the petals, and are made to extend their summits (the anthera) vertically, that they may be fully acted upon by the sun's rays, and thus receive the excitement which their construction requires; while the petals of the corolla, which afford a surrounding protection to the whole, are formed of the most delicate materials, that they may absorb only such portions of light, and of the moist and nutritive properties of the atmosphere, as may best suit the peculiar wants of the other parts of the flower. In this manner, the first materials of the new plant are protected and nourished, until by their progressive advance they are rendered fit for future developement; and this being accomplished, they are left to their own resources; the auxiliary instruments of protection and nourishment dying away and dropping off, when their services are no longer required. So beautiful and so uniform is the order of nature! So wonderful and so consistent are all her works!

The pericarp, having thus been perfected in all its parts, the germination of the seed and the formation of a new plant become the next for consideration. But previously, as connected with the subject, it will be useful to know the means adopted by nature for the distribution of the various seeds, so as to afford that diversity of vegetable productions which we see adorn and cover the face of the earth.

If seeds were to fall into the ground merely by dropping down from the plant, from thus being collected in a mass, either the fermentative process would take place and decomposition and decay be the consequence, or such a partial vegetation would be produced, as would render a large surface of the globe destitute of verdure and of the supplies so essential to animal life; while the atmosphere, from numerous decompositions on the one hand, and from a deficiency of the renovating principle on the other, would lose its purity, and be no longer fit for the purposes for which it was created. But Providence has wisely ordered it otherwise. For in the place of this partial distribution, it is so arranged that this, like every other part of the creation, shall be subordinate to the rest; and that each shall take its respective share in contributing to the benefit of the whole. Thus in the vegetable world where each portion of it, from its contruction, is rendered helpless and incapable of extending itself beyond the spot which first gave it existence; the sources of propagation, by a very curious mechanism in some instances, and through a variety of mediums in others, are made to distribute themselves in all those directions which can render their perpetuation useful or necessary. Thus in some, the seed vessel is made to burst its integuments with an elastic jerk, by which its seed is thrown with violence to a considerable distance. Others again are covered with a spiral awn or spring, blended with a number of minute hairs which serve as so many fulcra, by which they cling to whatever objects come in their way; and the seed, thus attached, is kept in continual motion until it falls and germinates, or dies in the ground. Thus cattle, to which it frequently fixes itself, by moving from place to place, and depositing the seeds over a large space of ground, are often the instruments of this kind of distribution.

In other instances, a dispersion takes place from birds and other animals feeding upon the fruits of plants, and dropping the seeds after they have devoured the pulp. Some carry them away to a particular spot to make a hoard of them; and such as are not consumed, germinate and become plants. Others swallow the seeds, and afterwards deposit them in the soil without being injured. Our own species, we know, not only distribute the seed peculiar to our native climate, but also bring from the most distant regions the productions of foreign countries, and naturalize them to our own.

The winds, also, are another very powerful agent in the distribution of those seeds which are purposely constructed to be acted upon by their influence; as the lichens and other seeds which float invisibly in the air, and vegetate wherever they happen to meet with a suitable soil. Some are furnished with a light down, others by a membranous wing, and a third again are in themselves so light, that each of them float in the air and are carried in its current whichever way the wind may blow.

A last means adopted by nature for the dispersion of seeds, is the action of streams, rivers, and the currents of the ocean. "The mountain stream or torrent washes down the valley the seeds which may accidentally fall in it, or which may happen to be forced from its banks when it suddenly overflows them. The broad and majestic rivers, winding along the extensive plains and traversing the continents of the world, convey to the distance of many hundred miles, the seed that may have vegetated at their sources; while by the currents of the ocean, fruits and seeds, indigenous to America, have been deposited upon the western shores of Europe."

Thus nature, by means the most comprehensive, yet upon principles the most simple and intelligible, provides for the completion of all her works; and the more we examine her attributes, the greater proofs we obtain of the usefulness and ends for which her powers have been called into action.

Having explained to you the ingenious means employed by this omnipotent agent to distribute the rudiments of those productions that constitute the vegetable kingdom, we come now to the process by which they are called into vital action, embracing the germination of the seed, and the formation and completion of a new plant. But previously, it will be proper to inform you, that the seed in its ordinary state, (of which the bulbous root is only a variety,) possesses two distinct properties—namely, the principles of early nutriment, composed of a solid mass, in which starch, mucilage, and oil are chemically combined; and the rudiments of a future plant consisting of the radicle or embryon root in union with the plumula or primary stem. Both are secured in a strong capsule or shell, forming one or more lobes or cotyledons; some seed having only one lobe, as wheat, oats, barley, the grasses, and the like; and others, (which more frequently is the case,) two lobes. Of the latter, the kidney bean, the germination of which we shall presently explain, is an example. It is also of importance you should know, that seeds will not germinate, unless moisture has free access to them; and hence the use of watering or of rain after sowing and planting. That though a due proportion of water be applied, vegetation will not commence at a temperature below forty degrees, from which warmth is equally requisite with moisture to produce germination. That under the combined advantages of moisture and heat, the object cannot be obtained until air be admitted to the seed; hence the use of turning up the ground by frequent ploughing, digging, and raking; and that the admission of light is a great bar to the process, and therefore covering the seed with soil is a necessary practice.

Thus the external circumstances essential to germination, are water, a certain degree of heat, atmospherical air, the exclusion of light, and in general, (though not always,) the agency of the earth.

Having made you acquainted with the structure of the seed, and the requisite circumstances to produce vegetation, the succeeding process admits of easy explanation.

It has been previously observed, that most seeds have one or more cotyledons or lobes, containing a quantity of farinaceous matter laid up on purpose to supply the embryo plant with food as soon as it is required. This food, however, must undergo some previous preparation, before it can be taken up by the plant for the formation and completion of its respective organs; and such an effect, it is obvious, can only be produced by chemical agency. When a seed therefore is committed to the earth at any temperature above forty degrees, it imbibes water, which softens and swells the cotyledons, and decomposing the external coat, it admits the absorption of oxygen from the atmosphere, which combining with the carbon in the seed, carbonic acid gas is generated and set at liberty. This loss of carbon increases the proportion of oxygen and hydrogen in the seed, and excites the saccharine fermentation, by which the farinaceous matter is converted into a sweet emulsion; while the vessels in the seed begin to expand and ramify in every direction in each lobe from the circumference to the centre, until they terminate in a single tube, forming the channel by which the nutritive fluid is conveyed into the radicle of the embryo plant. The vital principle being thus excited, the gases set at liberty by the fermentative process, cause the seed to burst, and the cotyledons to be rent asunder. The radicle now meeting with no opposition, strikes into the ground, and forms the root of the plant; and sending through its tube, a supply of the newly prepared liquid to the plumula, (previously distended by the heat of the process); the plumula also begins to expand, until it forces its way above the surface, and forms the early stem, carrying with it the cotyledons; which, as soon as they come in contact with the air, spread themselves laterally, and are converted into leaves, and from this circumstance, they have been termed *the seminal* or *seed leaves.*

These leaves continue to supply the young plant with nutriment, until the root has extended itself into numerous ramifications, capable of absorbing nourishment from the ground, and until the upper leaves have been formed; when the assistance of the latter being no longer required, they gradually decay and drop off: the plumula then becomes a regular stem, and progressively sends out branches and leaves, until the plant in all its beauty and perfection, has been completely developed and formed.

Such is the process observed by nature in the production of the kidney bean, lupine, cucumber, and various other vegetable productions; while in many, the cotyledons, without forming seminal leaves, supply from below the surface, the requisite nourishment; until the plant, by its advancement in growth, is rendered independent of their aid.

This process has not been inaptly compared by many naturalists to the incubation of the egg; in which the yoke and albumen supply the place of the vegetable cotyledon in furnishing the embryo chick with nutriment, until it can obtain its own food; and like every other in the vegetable economy, I am sure you will coincide with me, is full of beauty and providential care, wonderfully calculated in all its parts to render the means subservient to the end, and strikingly illustrative of the unerring laws and principles by which the natural world throughout is governed and regulated.

Having previously explained to you, when treating on the functions of the leaves, the manner in which the plant, when completely formed, is nourished and preserved; the cause of the sap's ascent, is the only part of the physiology of vegetables, which, to the best of my recollection I have omitted.

Upon this interesting subject which, at various periods, has engaged the attention of philosophers without any satisfactory results, my time will not allow me to dilate. All I can briefly say, is, that the ascent of the sap varies according to the season of the year, and the state and temperature of the weather; being suspended during the winter, and most active in the spring, when vegetation recommences, and previously to the full expansion of the leaf; that at the vernal season, Dr. Hales has ascertained by experiments on the vine, in the heat of the day it will rise in glass tubes adjusted for the purpose, at the rate of an inch in three minutes, and attain in these tubes the height of more than twenty feet; and that, by its force upwards, it will sustain a column of quicksilver, of thirty-eight inches, equivalent to the pressure of a column of water of more than forty-three feet; which force, he says is, "five times greater than that of the blood in the crural artery of a horse, seven times greater than that of a dog, and eight times greater than the blood's force of the same artery in a fallow deer."

The cause of this ascent of the sap has been variously explained by different naturalists; some attributing it to the action of temperature upon the fluid, by which it ascends from the diminution of its own gravity; some to capillary attraction, and others, (and those more generally) to the exciting action of the sap itself upon the irritable fibres of the vessels, causing them to contract and propel the fluid upwards.

I shall conclude this day's paper by a few observations upon the varieties and uses of the vegetable kingdom.

In our daily observation, the surrounding vegetable substances are so constantly before our eyes, and many of them in such habitual use, that we are too apt to pass them by as unworthy of our regard; and unless some striking feature of country, or some peculiarity in its productions awaken our attention, to neglect an investigation which, by a more laudable curiosity, would have afforded us a gratification of the deepest interest.

In this, and in many other countries of Europe, with a climate unfavourable to luxurious growth, and where cultivation has subjected the principal portions of the soil to the domestic uses of man; vegetation may be considered to be nearly artificial, and nature is only seen under a disguised garb; evincing indeed to what perfection, through skill and industry, the minor or herbaceous species of the vegetables may be brought, but excluding in a great measure from our observation, those grander productions of the vegetable world, which at once astonish us by the magnitude of their growth and the variety of their species, by the noble expansion of their foliage, and by the unrivalled and variegated tints of their blossoms and fruits.

We may indeed admit that Europe, in its more barbarous eras, presented to the stranger, thick and extensive forests of natural growth, though by the progress of civilization, we see comparatively but little of them at the present day; and that our fields and our gardens, while they confer rural beauty on our scenery and habitations, reward the labourer's toil with plenteous returns in situations, where, from the unkindness of the soil and climate, the coarser vegetation only once held a place. But these facts display upon a very limited scale only, the extent of what is to be understood by the vegetable kingdom. It is in latitudes approaching the equator, and in the southern continent of America, where the climate is favourable, and where nature has been the least disturbed in her operations, that we find vegetation in its fullest luxuriance, variety and grandeur. Where the European herbaceous plant becomes a shrub of no trifling dimensions; the shrub, a tree; and the tree, a noble column of massy circumference, and of broad umbrageous foliage, of which, *in our* less congenial climates we have no example; nor without experience can we form any thing like an adequate idea. Where hills rise upon hills in amphitheatrical order, covered to their very summits, and closely invested with vegetation upon the grandest scale and unbounded variety; and where a perpetual renovation and succession preserve an uniform mass of foliage throughout the whole year.

Among the more striking specimens of tropical vegetation, may be mentioned the palmetto altissima, or cabbage-tree, of the West Indies, the trunk of which, measuring about seven feet in circumference at the base, ascends in pyramidal and columnar order, without a branch or a leaf until it reaches two hundred feet in altitude, when, tapering to a fine point, it sends off in every direction a lofty crown of fronds like plumes of ostrich feathers, which gracefully waving in the air, form one of the noblest objects of the vegetable creation.

Bryan Edwards, in his History of the West Indies, has happily described the beauty and richness of its mountain scenery; more especially as it appeared to Columbus upon his first visit to Cuba. He says, "As these countries were *at that time* extremely populous, both the hills and the vallies were necessarily cleared of underwood; and the trees which remained, afforded a shade that was cool, airy and delicious. Of these trees, some, as the papaw and the palmetto, are without doubt the most graceful of all the vegetable creation. Others continue to bud, blossom, and bear fruit throughout the year. Nor is it undeserving of notice, that the foliage of the greater part of them springing only from the summit of the tree, and thence expanding into wide spreading branches closely but elegantly arranged; every grove is an assemblage of majestic columns supporting a verdant canopy, and excluding the sun without, *at that time*, impeding the circulation of the air. Thus the shade, at all times impervious to the blaze, afforded not only a refuge from occasional inconvenience, but a most delightful retreat and habitation. Such were these orchards of the sun and woods of perennial verdure, of a growth unknown to the frigid clime and less vigorous soil of Europe!" And speaking of their present state, he says, "for what is the oak compared to the cedar or mahogany, of each of which the trunk measures from eighty to ninety feet from the base to the limbs? What European forest has ever given birth to the stem equal to that of the ceiba or wild cotton tree; which alone, simply rendered concave, has been known to produce a boat capable of containing one hundred persons? Or the still greater Indian fig, the sovereign of the vegetable creation—*itself* a forest?"*

* The ficus indica, or banian tree, may be considered one of nature's most splendid productions. It consists of a woody stem, with branches of vast height, terminating at their summits with a noble mass of foliage, each branch sending out at certain distances and at a considerable elevation, smaller ones, which descending gradually, reach the ground, where they take root, and in time become trees as large as the parent stock; and as the foliage is confined to the summits of the trees, which, uniting, form an umbrageous canopy, impervious to the hottest beams of a tropical sun; we may easily comprehend, why these facinating groves are made the resort of the religious recluse, as the Brahmins of India, or of such

Such is Bryan Edwards's brief account of the grandeur of tropical vegetation, as it appears in the larger islands of the West Indies; the accuracy of which, we can, from very gratifying experience, most amply confirm. But these effusions of vegetable nature are not confined to those islands. They extend to the continent of America also, as well as to many parts of Africa and Asia; of which, had our time permitted, we could have presented a long list of magnificent examples. We can only now generally observe, that the *varieties* of vegetable productions in those climates are equal to their grandeur; and that as we recede from the equator and approach the poles, those varieties diminish, until vegetation is limited to the lowest grade in its scale. Thus it has been computed, "that at Spitzbergen, which is in the eightieth degree of north latitude, there are only about thirty species. In Lapland in the seventieth degree, about five hundred and thirty-four. In Iceland, in the sixty-fifth degree, about five hundred and fifty-three. In Sweden, which reaches from the southern part of Lapland to the fifty-fifth degree, one thousand three hundred. In Brandenburgh, between the fifty-second and the fifty-fourth degrees, two thousand. In Piedmont, between the forty-second and forty-

of the natives, whose love of retirement, may lead them to frequent their walks, or to repose themselves under their impenetrable shades.

sixth degrees, two thousand eight hundred. In Jamacia, between the seventeenth and nineteenth degrees, four thousand. And in Madagascar, situated between the thirteenth and twenty-fourth degrees under the tropic of capricorn, more than five thousand."

I must now trespass a few minutes more on your time, while I claim your indulgent hearing to some concluding observations upon the uses to which nature has applied this fascinating portion of her wonderful works.

The vegetable kingdom may be considered one of the principal instruments by which Providence keeps in union the several parts of the natural world, and promotes its respective operations. Without it, the earth, from a deficiency of covering, would soon lose its texture; and its integral parts being exposed, its aggregation would be disjointed and destroyed by the operation of the other elements. The atmosphere, whose purity and elasticity, as we more than once have observed, depend upon vegetable evaporation, would no longer preserve animal life, or by its pressure keep in due place the minuter parts of which the crust of the globe is composed; while the various animals, many of them of vast magnitude and powers that now may be considered graminivorous, would become beasts of prey, that would soon depopulate the world, and with the other causes, render it a mass of chaos and desolation. Even man would become gross and ferocious; and his energies being no longer called forth, or his intellectual powers exercised, he would soon become more dangerous than the beasts of the forest by which he is surrounded, and the world would have been created in vain. But it has been wisely and most benevolently ordained to be otherwise. In the place of a rough and unseemly covering which the earth would in that case present to the eye, or that disturbance of its several parts which would render it useless to the purposes of creation, or inaccessible to human approach; we uniformly find in all those countries most fitted for the occupation of man, vegetation abounding in all its beauty and usefulness—giving life and character to the surrounding scenery, and preserving in due form and place the several parts in all their natural shapes, proportions and distances—affording capabilities of production suitable to the constitution and wants of those that are dependent upon it for its supplies—preserving in due purity and equilibrium the varying states of the atmosphere, constantly deteriorated by animal respiration, combustion, and mineral absorption—*and above all*, conferring on man, indubitably the first object of the creation, those comprehensive resources and excitements to action through the operation of which his intellectual and moral powers have been developed, and his social propensities have been directed to the most useful ends.

Hence the forest, or vegetation upon its largest scale, by the shelter it afforded, laid the foundation for the science of architecture, probably among the earliest of human efforts, since brought to such useful and ornamental perfection. Hence the smaller vegetable productions, which, in a certain degree, the earth also naturally afforded, and from which man in his primitive state derived his principal, if not only support, becoming disproportioned to the advancement of population, gave rise to the invention of agriculture, and progressively to all the improvements of which it has since been found susceptible; now forming the pillar stone of human wealth and grandeur—the basis of modern commerce—and, *in this favoured country*, the link by which the best interests of society are kept together, and the national character preserved in its utmost purity.

From a more perfect knowledge of the properties and capabilities of the different vegetable substances, and which architecture and agriculture, and the various inventions to which they have given rise, have greatly promulgated; we have obtained those materials that now give employment to our mechanics and our various manufacturers; by which we are furnished with materials for the chief part of our buildings—with ships for our protection and commerce—with our carriages of every kind, and the furniture of our houses—and, we may briefly add, with nearly every solid article of luxury and convenience which the ingenuity of man could devise.

Advancing in our acquaintance with vegetables, we are enabled to extract from plants and trees, a vast variety of substances which contribute to our wants or mitigate our sufferings, which give an impulse to our industry, or which form the best sinews of our commerce. Thus, independently of *their indirect* operation as affording sustenance to various graminivorous animals, by which we obtain our cattle, and from them our hides, our wool, our leather, our candles, our butchers' meat, and the various articles of our dairy; and to the insect tribe, through which we procure our honey and wax, one of our finest colours, and our silks in all its varieties: they *directly* supply us with our oils of commerce and of medicine; our gums and valuable woods; our corn for our own use, and food for our cattle; our table vegetables and fruits; our wines, foreign and domestic; our malt and spirituous liquors; our tea, coffee, sugar, rice, and all our farinaceous articles of nourishment; our flax, hemp, and cordage for our vessels; the greatest proportion of our most valuable medicines; and in a few words, with almost every article that can be useful to man, or through which our wants can in the greatest degree, be supplied. And if, to these considerations, we add *the domestic tendency* which an improved knowledge of vegetation has introduced; as evinced by the taste displayed in our estates and gardens, by an improvement in our vegetables and fruits, and by the deep interest we take in all those rural circumstances, those local peculiarities and those associations which a country life alone can bestow, and which, by their fascinating tendency so frequently rivet us to the spot in which we fix our residence; we shall then know how to appreciate the importance of the vegetable kingdom, in the scale of the creation; we shall at once see how immediately it is interwoven with our nature and our wants, our pleasures and our occupations; and we shall feel an irresistible desire to become more familiar with a portion of the universe, so wonderful in its mechanism and attributes, so comprehensive in its application and laws, and throughout its minutest ramifications, so visibly stamped with the hand, through whose divine agency alone, all things animate and inanimate are regulated.

In case we may not have rendered the preceding account of the structure and functions of vegetables sufficiently perspicuous, we have introduced the following explanatory Table, a copy of which was printed on cards, and distributed at the time the Lecture was delivered.

EXPLANATORY TABLE,

REFERABLE TO THE
PRECEDING LECTURE
ON

VEGETABLE PHYSIOLOGY.

ANATOMY.——Description of each part of the structure of the plant.

PHYSIOLOGY——Treats of the functions and uses of each part.

VEGETABLE CHEMISTRY ——Explains the primary elements of plants, consisting of carbon; a small portion of nitrogen, one of the constituents of the air; of hydrogen, one of the constituents of water; and of oxygen, which, combined with nitrogen, forms the atmosphere, and with hydrogen, water. All these are variously and chemically combined in the plant.

AGRICULTURAL CHEMISTRY.——A knowledge of the influence of the atmosphere on vegetation, and of the constituent parts of those substances that contribute to the growth and increase of plants; including the different soils and the means by which they can be improved.

SIMPLE BOTANY.——A classification and arrangement of plants, so as to distinguish one from another.

GENERAL PHYSICAL STRUCTURE OF PLANTS——Originally only of two parts, viz. fibres or tubes for the conveyance of the sap; and a tissue of cells for the reception of the vegetable fluids.

CAUDEX.——The main body of the root.

RADICULÆ.——The ramifications, or smaller fibres of the root.

EPIDERMIS, CUTICLE, OR OUTER BARK.——The external covering of every part of the plant.

CUTIS, OR INNER BARK.——Consists of a particular modification of tubes and cellular tissue, by which the sap *returns* from the leaves through the stem to the roots: nourishing in its progress the several parts.

CORTICAL VESSELS.——The vessels of the inner bark.

ALBURNUM.——The live or sap wood, consisting of cells and tubes, through which the sap *ascends* from the root, through the stem and branches to the farthest extremity of the leaves, there to receive the the requisite changes.

THE HEART, OR DEAD WOOD.——The part of the wood in which the vessels have been obliterated by pressure in advanced age, and is only to be seen in old trees.

THE PITH.——A soft spongy substance, composed of a tissue of cells, filled with a watery fluid, situated in the centre of the root, stem, and branches, intended to promote the growth of young shoots.

PEDUNCLE.——The uniting stalk of the leaf, or flower, to the parent source.

CALYX.——The cup that supports the flower.

COROLLA.——The blossom, consisting of the whole of the leaves of the flower.

PETALS.——The leaves of the flower separately.

RECEPTACLE.——The base of the flower, upon which the other parts rest.

NECTARIUM, OR NECTARY.——A small sac. or bag, containing honey, generally situated in the petals of flowers.

STAMENS.——Small thread-like substances within the corolla, divided into anther and filament.

ANTHER.——Small prominent bags at the top of the stamen, containing the dust which forms the great fertilizing principle.

FILAMENT.——A fine line or thread passing from the anther into the receptacle.

PISTIL.——A column-shaped substance, in the centre of the flower, consisting of the stigma, style, and ovary.

STIGMA.——A small glandular-looking substance, of a triangular form, at the top of the pistil.

STYLE.——The middle portion of the pistil.

OVARY.——The base of the pistil, which fertilized, produces a new plant.

POLLEN.——The farina or dust, contained in the anther of the stamen, which, dropped on the stigma of the pistil, fertilizes the ovary.

THE SEED——Consists of the cotyledon and the embryo plant.

THE COTYLEDON.——That portion of the seed which by a chemical process is converted into nutriment to supply the embryo plant, THE EMBRYO, OR INFANT PLANT.——That part of the seed which is formed of the primary radicle, expanding ultimately into a regular root; and of the plumula which ascends and becomes the stem or trunk, and gradually the complete plant or tree.

NUTRITIVE ORGANS ——The root and leaves.

NUTRITIVE PROCESS.——The capillary extremities of the radiculæ, or smaller fibres of the root, enter the earth in different directions, and absorb therefrom nutrient materials held in solution by water; and convey the fluid to the caudex, and thence into the cells of the alburnum or sap wood, from which it is forwarded by tubular vessels, through the stem and branches, to the leaves; where, by exudation, it parts with its superfluous water and gases, and by absorption, takes up new ingredients from the atmosphere, and forms the true sap. The sap, thus perfected, is then conveyed back from the leaves by another set of tubular vessels (termed cortical) into the cells of the bark; and from thence, supplies of nourishment are forwarded to every part of the plant, including the branches, stem and roots.

RE-PRODUCTIVE ORGAN.——The flower, terminating in the fruit and seed.

RE-PRODUCTIVE PROCESS.——The anthera, situated at the summit of the stamen, and consisting of small globules, having reached their fullest degree of expansion, burst, and dropping their farina upon the stigma of the pistil, they fertilize the ovary, which then enlarges, until a new flower, and afterward the fruit are formed, in which is imbedded the seed, containing the rudiments of a new plant.

GERMINATING AND VEGETATIVE PROCESS.——The seed being deposited in the earth, by the chemical agency of heat and water expands, until its outer coat bursts; when the primary radicle (already explained) first dips into the earth, and forms a root. The plumula then ascends, and becomes the stem, and carries with it the cotyledons, which now, by chemical agency, being endued with nutritive properties, expand and are converted into leaves, from which they supply the young plant, until the common leaves have been formed, and until the radicle below has sent out branches sufficient to absorb nourishment from the ground. The cotyledons then, no longer being required, die away, and the plant advances until it is completely formed into stem, branches, and leaves.

LECTURE III.

ON ZOOLOGY.

In the last session I had the honour of reading to you a paper on the vegetable kingdom; in which I endeavoured to illustrate some of its leading phenomena, its importance in the economy of nature, and the very comprehensive utilities of which it is susceptible. I shall now beg to call your attention to a much higher grade in the scale of the creation, *the animal kingdom*, the science of which has, by naturalists, been denominated—*zoology*, a greek derivative, which signifies a discourse on animals.

I will not trespass on your time in discussing the doctrine of some modern philosophers, who would wish to make it appear that animals are only a superior order of vegetables; that vegetables are the intermediate bond of union between animals and minerals; and that man is only the first in the graduated link of created substances. I shall merely observe, that independently of the wide and obvious distinction between the three kingdoms of animals, vegetables, and minerals, as it strikes the senses, and which by the most fastidious can hardly be denied; the vast elevation at which man is placed above every other part of the creation, produces so great a break in this imaginary chain, as at once to convince us of the absurdity of the hypothesis; and how presumptuous it is in us, limited as our understandings are, to attempt the explanation of laws which, emanating from a much higher authority, are, for very wise purposes placed beyond the reach of our comprehension.

It will be sufficient to know, that animals are organized, animative, sensitive bodies, which seek their food according to the dictates of their taste and appetite, and *voluntarily* introduce it by a mouth into a stomach, there to be subject to various processes which do not belong to the economy of either minerals or vegetables; that through the agency of a brain and nervous system, or by a mechanism producing a similar effect, they are endued with a variety of other attributes, to which neither vegetables nor minerals can lay claim; and that by their locomotive powers, they in most instances possess a range of action, which conclusively distinguishes them from every other part of the creation.

To qualify us to have a knowledge of the animal kingdom in all its varieties and comprehensiveness, it is requisite that we make ourselves acquainted with the external character of each species, previously to our entering upon their habits, peculiarities and the structure and functions of those organs, by which their lives are preserved, and their various movements regulated. The one, though requiring some exercise of the memory and a patient attention to arrangement and classification, is a subject of much curiosity and instructive amusement. The other, when duly contemplated, a theme of the deepest interest, and most conclusively illustrative of the contrivance, wisdom, and benevolence, by which every part of the creation is so uniformly to be distinguished.

When we reflect upon the almost endless variety of animals which inhabit and enliven the globe, embracing our own species, quadrupeds, birds, the amphibia, fishes, insects, and worms; we shall readily comprehend the difficulty of fixing upon our memories even a moderate proportion of their species, without the aid of such a classification or arrangement as founded upon physical resemblances, may qualify us to recognize them when brought under observation. And this has given rise to what has been termed a system, or such a division of the subject into parts, primary, intermediate, and subordinate, as may enable us, by a reference to some particular head, gradually to become acquainted with the several individuals of which the whole is composed.

Of the necessity of such an arrangement, the ancients, many of whose learned men were partial to the study of natural history, were fully aware; and we accordingly find that, Aristotle, the great naturalist of former times, whose system of zoology has been brought up to a late period, divided animals first *generally* into *viviparous* or those which produced at once living animals; and into *oviparous*, or such as produced eggs from which their young were afterwards to be excluded. And next *particularly* into classes orders, and species, according to their external form, to their food, their habits, and their habitations. Of this very simple and natural system, Aristotle was aware of the defects; it being of too general a nature to embrace under its respective heads all the several individuals, numerous as they necessarily were, that required illustration. He therefore recommended to future naturalists, that, as the knowledge of anatomy advanced, the *particular* structure of animals, internal as well as external, should form the basis of their improved systems of zoology. This classification, however, continued until nearly the close of the seventeenth century, when our celebrated countryman, Ray, availed himself of Aristotle's suggestions; and observing that the structure of the lungs and heart varied in different animals, he struck out a new arrangement, founded upon the peculiarities of those organs; which took the lead until the time of Linnæus, who, improving upon the classifications of both Aristotle and Ray, framed a code of zoology, which, with some modifications by Cuvier and Blumenbach, may be considered the prevailing system of the present day.

Linnæus first arranged the whole animal kingdom under three grand divisions as derived from the structure of the heart, and the colour and temperature of the blood. He next formed animals into six classes, each having reference, not only to the circulating system, but also to some other peculiarity in the animal. Thirdly, into orders according to the structure and functions of a particular external part. Fourthly, into genera, from *some general* varieties in their conformation; and lastly into species, from a still greater diversity in their external peculiarities.

In the first grand division, the animals have a double heart, that is, an organ containing two great cavities, or ventricles, and two smaller ones, or auricles; and, as the blood of these is of a warmer temperature than the common atmosphere, and is of a red colour, they have been denominated *warm, red-blooded animals*. They embrace our own species, land quadrupeds, birds, and the whale tribes.

The animals in the second division, are distinguished by a single heart, having only one ventricle, and one auricle; and in these the blood though red, is of a lower temperature than the common atmosphere, and therefore they have been denominated *cold, red-blooded animals.* They consist of the perfect fishes, (whales excepted) land and sea tortoises, frogs, toads, lizards, and the various species of serpents.

To the third and last division belong those animals, which, with a doubtful heart, in the place of red blood have only a cold, whitish, and nearly colourless fluid, and these in consequence have been denominated, *cold, white blooded animals.* To this division belong the insect families, and the crustaceous shell fish; and the worm tribes, including the testaceous shell fish, and zoophites.

Taking the above as a basis, the six classes of Linnæus have been formed in the following order.

Firstly. *Mammalia, warm, red blooded animals,* with a double heart, which give suck to their young, and are *viviparous,* including our own species, land quadrupeds, and the whale tribes.

Secondly. *Aves, warm red blooded animals,* with a double heart, which are *oviparous*; including the different species of birds.

Thirdly. *Amphibia, red cold blooded animals,* with a single heart, and breathing with lungs, of which they have the voluntary command so as to suspend respiration for a very extraordinary time at pleasure without injury to themselves, consisting of land and sea tortoises or turtles, frogs, toads, lizards, camelions, crocodiles, alligators, and serpents.

Fourthly. *Pisces, cold red blooded animals*, with a single heart, which breathe through gills in the place of lungs without the power of suspending respiration; embracing all the perfect fishes, with the exception of the whale tribes.

Fifthly. *Insecta, cold white blooded animals*, with an imperfect single heart distinguished from worms by having antenna, or small horn like processes, including the various species of insects, and crustaceous shell fish, as lobsters, crabs, shrimps, and the like.

Sixthly. *Vermes, cold white blooded animals*, with an imperfect single heart, having tentacula in the place of antennæ, and embracing the various species of worms, testaceous shell fish, as oysters, muscles, and the like, and zoophites.

Each of the above classes has been subdivided (as we have previously intimated,) into orders, genera, and species; but as our object has been rather to explain *the principle* of the system than to trouble you with the detail, we must refer you to the several works that have been published on the subject for the further particulars.*

Cuvier, who, it appears, has directed his atten-

* A more detailed account of Linnæus's classification is to be seen in his General System of Nature translated by Dr Turton, in the smaller edition of Bingley's Animal Biography, and in most of the Encyclpœdias.

tion more particularly to anatomical investigations than Linnæus, noticed with great truth the discriminating varieties which exist in the *cerebral* or *nervous* system, as well as in the circulating organs of animals; and that all red blooded animals have a cranium, in which is contained a brain, and a vertebral column containing a spinal marrow, from both of which the nerves emanate; and therefore these, embracing the four first classes, or more perfect animals of Linnæus, he has denominated *vertebral*. And that all white blooded animals, as insects and worms, have not only doubtful respiratory and circulating organs, but have also a deficiency, or rather want of vertebral canal; and such animals he has in consequence classed under the head of *invertebral* animals. From these two grand distinctions, he has formed his subdivisions, classes, orders, and genera, into which he has entered more copiously than his predecessor, Linnæus.

Blumenbach has adopted the classification of Linnæus, but has deviated both from that naturalist and from Cuvier in many of his orders; in which he has adverted not only to the varieties in the external structure of animals, but also to their voluntary organs.

The suggestions of such distinguished naturalists as Cuvier and Blumenbach, cannot fail to improve most importantly the science of natural history; but until the whole of the existing experience has been concentrated and reduced to one established system, we cannot do better than follow that of Linnæus; which, though defective in some of its analogies, is sufficiently explicit to qualify us by due application to become acquainted with the several individuals to which it has reference.*

As I propose to enter particularly upon the history of each animal upon some future occasion, I now beg to remark that the *general* circumstances of animals most deserving of your notice, are those peculiar attributes which distinguish them from vegetables; the structure and functions of their more important organs; their habits and propensities; the measure of their intellectual capacities; and how, and in what manner, they contribute to the happiness and welfare of our own species.

When we contemplate the variety of living substances with all their capabilities and movements which constitute the animal kingdom; and when we observe the order and uniformity with which, through some superior agency, each performs its respective duties uninfluenced by the other, and the peculiar mechanism by which these various attributes are acquired; we are at a loss how to

* For the information of such of our readers as may be desirous of comparing the new systems with that of Linnæus; we have subjoined, at the end of our lecture, condensed tables of the classifications of Cuvier and Blumenbach.

fix our attention, or where we shall have the greatest reason to admire the wisdom and contrivance by which so many animated bodies with each its own peculiar laws, have been preserved in individual uniformity, and yet contributing to the general harmony of the whole. For though animals, for the conveniency of acquiring a readier knowledge of all their varieties, have, by human arrangements, been divided into perfect and imperfect; yet in nature there is not *one* living substance but is endued with the properties, essential to its respective duties; and it is the *relative* qualifications, as compared with those of other animals, that alone constitute the difference. Throughout every species indeed such an attention has been paid to the necessities of each, as well as to the means of performing its various functions; that we cannot but consider every part of the animal kingdom as one grand system in which no portion of it is defective; and however comparatively limited in action some of its members may appear, yet it may well be doubted, if greater powers had been assigned to them, whether such an interruption to the movements of the other parts of the system would not have been produced, as might at once have defeated the object for which the whole was created.

In a former paper, when treating on the vegetable kingdom, we took the opportunity of drawing a comparison between vegetables and animals, for the purpose of more fully illustrating the respective attributes of each, and their relative rank in the scale of the creation. We then observed, that vegetables were organized, living substances, occupying a large portion of the surface of the globe, in which they acted a very important part, and contributed in a most essential degree to the support of another class of living substances, denominated animals; a large portion of which, without their aid, would perish, and their species be annihilated.

That to qualify them to produce these important effects, they are endued with a very curious piece of mechanism, consisting of vessels or tubes, and of cells, variously arranged and combined, through the agency of which they absorb from the earth, or spot in which they are fixed, those nutrient materials that are necessary for their growth, development, and perpetuation; and having accomplished their destinies, without consciousness and voluntary locomotion, they die on the spot which first gave them existence.

Thus vegetables, which *involuntarily* perform the purposes for which they are created, and being intended only to act a subordinate part in the grand scale of nature, did not require that higher order of faculties which we see distinguish the animal kingdom. It was sufficient that they lived to fulfil the limited purposes assigned to them, and without consciousness of their existence or a will to act for themselves, to grow and die where nature first had placed them.

Animals, on the contrary, having progressively bestowed on them higher places in the scale of providence, necessarily required a more comprehensive field of action, and consequently a capability of movement, and a peculiarity of structure, for which, vegetables, in their more limited sphere, could have no possible use.

Thus in the place of being confined to the same spot under one uniform routine of movements, where cause and effect meet with no interruption as in vegetables, we find animals in most instances ranging at large from place to place according to the impulse of the moment; selecting their food as their taste or appetite shall suggest; suffering at one time all the deprivations and consequences to which a scanty supply may expose them; at another, indulging to the fullest extent of their wants. We see them capable, through the operation of their senses, of discriminating between those substances which are salutary to their constitutions, and those which are injurious; of ascertaining the approach of their enemies, and by their locomotive powers of flying from, or by their offensive weapons repelling their attacks. Through the same sources, with some few exceptions, they are open to those excitements that are productive of pain and pleasure in all their possible varieties—to the depressing passion of fear, and to the more encouraging one of hope—to great partialities, and to strong dislikes—to jealousies, and to other angry feelings—and in short, to all the sensations which the excitement of a very irritable organ like the brain, is calculated to produce. And if to these attributes we add those of sagacity on the one hand, by which many of them display a varied proportion of knowledge, and the power of discriminating in a certain degree the motives of those which surround them; and of contrivance in the other, as evinced in many of their habitations, in their receptacles for food, and in their repositories for the future accommodation of their offspring; we shall at once see the distinctive line which has been drawn between the two orders of living substances, and what a wide field is open for investigating more minutely the laws, economy, and habits of a portion of the creation, so deeply interesting in its varied attributes, so instructive in the lessons which it inculcates, and so useful and so comprehensive in all its practical applications.

Having pointed out a few of the leading particulars by which the animal is to be distinguished from the vegetable kingdom, and having endeavoured to explain the grounds upon which the former holds so high a place in the creation; we are naturally anxious to enquire into the structure and functions of those organs by which so many wonderful movements are produced; and this would lead me into the anatomy and physiology of animals, a highly interesting subject, but of too comprehensive a nature to admit of more than a cursory view of a few of its principal phenomena.

Since the vegetable world, among other objects, was intended to assist in the supply of food to animals; its resources, great as they appear to be, would have been too limited to support the vast variety and increasing numbers which now inhabit the globe, had not other means been adopted to make good the deficiency; and as by so great an addition to the animal world, many parts of which have a tendency to multiply in very extraordinary proportions, the earth would have been too small for their accommodation; providence has ordained that animals shall destroy and live upon each other; and thus by confining the proportion within just bounds on the one hand, and by multiplying the resources for food on the other, the order of the creation has been so balanced in all its several parts, as to allow no one portion of it to preponderate to the injury of the other.

This dispensation, which at first sight appears to have a cruel tendency, and therefore to be at variance with the attributes which we have usually assigned to the supreme Being, if closely examined, in all its practical applications, will be found to originate in mercy and benevolence.

The great enjoyment of animals seems to depend upon the gratification of their appetites, and the free use of their limbs; as evinced in the eagerness with which they devour their food, in the impatience they discover under restraint, and in the latitude which they take when removed from confinement. If therefore they were *all* to be limited to a vegetable diet, and to be deprived of the gratification which a very large proportion of them now derive from the pursuit of their prey; and if by such an arrangement, the enjoyments of an active life, (now so visible throughout the whole animal kingdom) were *uniformly* to terminate in the sufferings and infirmities of old age; animals *in that case*, would not only be confined to a very small proportion of happiness, but be also subjetced, as they grow old, to utter want and helplessness; since they would not be open to the protection and care, which, in our own species, afford a solace to age, and soften, if they cannot remove, the infirmities to which it is liable. Providence has therefore limited these calamities to a comparative few: and has bestowed a wide range of enjoyment upon a very large proportion, upon the condition that their lives (of the value of which they are not conscious, and which must at some time be forfeited) should be subject to such abbreviation, as might contribute to the common benefit of the whole, without bearing too heavily on any particular portion. Thus what appears to be at first view an evil, proves upon investigation to be a positive good; and that which carries with it the *external* complexion of cruelty, when examined more closely, is found to have originated in the most comprehensive benevolence.

The creation of animals below the human species, and the laws by which they are governed, appear to have been intended principally for the wants, and pleasures, and the conveniences of man; and as these were made to depend upon circumstances, which, by the influence of climate and the progress of civilization, would necessarily be fluctuating; it seemed essential not only that animals should be limited in their numbers by destroying each other, and that their lives more especially be at human disposal, but that they should possess those physical and intellectual peculiarities which in so remarkable a degree distinguish them from the vegetable part of the creation.

As on the present occasion it is my intention to confine myself to *general* observations, it will sufficiently answer my purpose, without entering upon the nicer distinctions of structure, to mention a few of those *physical* properties which appertain to animals in common, but especially to the more perfect ones, through whose agency those wonderful effects are produced, that confer so much dignity and interest upon the subject.

One of the first propensities of animals, and which, as being essential to their very existence, may be considered the most important, is the gratification of hunger; through the agency of which, the vital principle is preserved, and the several parts of the animal system kept in due tone. To promote this sensation, nature has caused the stomach of animals to secrete a very active fluid, denominated *the gastric juice*, which, possessing a solvent power over various substances, contributes in a very remarkable degree to their digestion. As soon therefore as the latter process has been completed and the stomach becomes empty, the gastric fluid acts directly upon its internal coats, and causing their fibres to contract, it produces that pain or disagreeable sensation which we denominate hunger; and as this is only to be relieved by a fresh application of extraneous matter, animals are *instinctively* taught to seek out those substances, which, under the denomination of food, are the best calculated to relieve the uneasiness; nature having bestowed on them the faculty of taste, to enable them to discriminate and avoid injurious articles, and to relish their food, so that it be taken in due proportions, and be sufficiently divided, previously to its undergoing those future processes upon which its ultimate digestion is made to depend.

The principal source of taste, it is well known, is seated in the tongue; an important organ placed in the mouth, to the under part of which it is partially attached by muscles connected with the contiguous bones so as to serve as a fulcrum for those various motions, which, while they increase its functions as an organ of sense, and in man of speech, contribute to the forwarding of the masticated food into the passage leading to the stomach: and in order that the sensation of taste be effectually called into action, the upper surface of this organ is covered with very numerous papillæ or extremities of nerves communicating immediately with the brain, and so arranged as to be instantly acted upon by the application of any substances calculated to produce excitement. As this effect is varied according to the articles applied, we may easily comprehend how animals discriminate one substance from another, and the degree of enjoyment which nature intended they should derive from the gratification of an appetite, of which hunger is the principal cause.

We have here two very ingenious contrivances by which the important sensations of hunger and taste are called into full activity. And as without either of these powerful excitements, animal life would soon have been extinguished, the one from poisonous substances being indiscriminately swallowed in common with others, the other, from a total neglect of food; we cannot sufficiently admire the Providence which has thus so effectually guarded against accidents, which, in their consequences, would eventually have been destructive to the whole animal kingdom.

Upon the taste being gratified, and the *first operation* completed, namely mastication, the food is conveyed into the stomach, there to undergo *a second process*, that of digestion, and afterwards *a third,* the converting it into a milk-like fluid, denominated the chyle. This fluid is then absorbed and conveyed through a series of almost invisible glands into a tube, named the thoracic duct, which ascending, finally empties its contents into one of the large returning vessels of the heart, there to be intermixed with the deteriorated blood, brought from different parts of the body for atmospherical purification; thus subjecting the chyle or newly formed blood to *a fourth process,* namely, the respiratory, previously to its being in a fit state to nourish the body, and to supply the glands with materials for secretion.

We here see in the preparation of those supplies which in the first instance were necessary for the support of animal life, nature has employed no less than *four* important processes to effect her object; and as each of the organs concerned, was liable, from a variety of causes, to be so deranged in its functions as to interrupt her intention; it is obvious that great ingenuity was required in the mechanism, and a nice adjustment of its several parts, to secure the due effects which this very important part of the animal economy was intended to produce.

Having taken a general view of the organs of nourishment, and of the propensities which lead to their being called into action, we think it right you should be informed, that these in different animals are variously modified, according to their habits, and to the food to which they give the preference.

Thus in land carnivorous animals, as the obtaining of their food is often precarious, and when taken is frequently swallowed in large proportions, nature has given them not only active stomachs, but also voracious appetites, which lead them to tear their food to pieces, and to swallow it almost instantaneously. For this purpose, besides possessing very powerful claws to seize and retain their prey, they have in each jaw, six canine or sharp tearing teeth, and on each side a fang; their stomachs being peculiarly thick and highly muscular; and this, with an active gastric secretion, causes even very hard bones to be quickly digested. A rapid return of hunger is the necessary consequence; and as their supplies are often precarious, it renders *even tame* carnivorous animals greedy of their food, and those *in a wild state*, in the highest degree ferocious and blood-thirsty.

Graminivorous animals, on the contrary, or those which live *entirely* upon a vegetable diet derived from the surface of the earth, requiring a finer division of its several particles before a solution can be commenced, and whose food from being more uniformly at hand is obtained at much shorter intervals, are slower in their mode of eating and less voracious; and these are more easily domesticated than the former class, many of which under no treatment can be rendered subservient to human control. To enable the graminivorous animals therefore to prepare their food for digestion, in the place of sharp, cutting teeth, nature has given them those which are partially hollow and broad, that the food may be completely divided by mastication before it be passed into the stomach; and as its digestion afterwards is not so quickly affected as in carnivorous animals, it is subjected to the action of frequently more than one stomach; in the ox species, to as many as four; and in the latter, as well as in several other of the graminivorous class, to the further process of *rumination* or second mastication, previously to its final solution; the principal stomach being usually longer and thinner than that of carnivorous animals; while in the place of claws to the feet, the graminivorous have hoofs to give them a stronger hold on the ground. Those quadruped animals again which feed on the fruit and seeds of trees, have their legs formed for climbing, and their feet (like hands) for grasping round substances; and as these animals in their teeth and external structure approach the nearest to the human species, they have been placed by Linnæus in his first order, which he has denominated primates.

In our own species, which is destined to live upon a mixed food, animal and vegetable, the teeth are made up of incisors, grinders, and only four canine teeth, two in each jaw; and the stomach is intermediate in its strength, size and length, compared with those of the other two descriptions of animals.

To the bird species, part of which live upon raw flesh, and the other part mostly upon vegetable substances, we find no teeth have been assigned, but in the place of them, *bills*, of which those of the carnivorous birds have been made sharp and hooked to enable them to tear to pieces their food as done by quadrupeds of prey, and like them also, very active stomachs, to promote its rapid digestion. While in the *seminivorous* birds, whose food, from consisting of seeds and hard substances will not admit of this early division, and therefore is swallowed entire; its separation is effected in a thick, muscular bag, called *the gizzard*, whose rough interior acting upon small stones and other hard substances taken in by the animal, causes such a trituration of the food received into its cavity, as to render it fit for final digestion.

To further our illustration, had my time permitted, we might have descended to the comparative digestive organs of the *amphibia;* of *fishes;* and of the still lower order of animals, *insects* and *worms;* in which, though upon simpler principles, the same beautiful contrivance, and the same varied adaptation of the means to the end, have been displayed. But I trust I have sufficiently treated on the subject to convince you through what diversified resources Providence has effected her object; and while the different purposes of the animal have been answered, each living substance has been endued with the most ample means of enjoyment and preservation, consistently with the ends for which it has been created.

Having conducted the prepared fluid previously submitted to *three* distinct operations into the blood vessels, we are next led to inquire what further process is requisite to qualify it to answer the double purpose of nutriment to the body at large, and of affording those various secretions necessary to preserve in due tone its several parts.

In my former paper, when treating on vegetables, we noticed that the sap did not acquire a nutritive principle, until it had been deprived of its grosser materials by evaporation, and had taken up new ingredients from the atmosphere; and that this was effected by tubes, which conveying the fluid from the roots to the leaves, it was there by a very curious mechanism completely exposed to the action of the air, through which it was rendered fit to be returned to all the several parts of the plant, for the purposes of support and nutrition.

Animals require the aid of the same vivifying principle, since they cannot live, if deprived of atmospherical air. But as, from the peculiarity of their structure, a much more complicated mechanism is requisite, and as the process is so immediately connected with the first principles of animal life, a brief account of it, I hope, will not prove uninteresting.

To illustrate the comparative importance of the subject, I must again call your attention to the nourishing principle of vegetables, in which the food undergoes *no* preparatory process previously to its being submitted to atmospheric agency, but is absorbed from the earth in a fluid state, and is at once conveyed to the leaves to undergo the final preparation; while in animals, no less than three very compound operations are requisite, namely, mastication, digestion, and chylification, before it be in a fit state to be submitted to that atmospherical agency which is to impart the nutritive property; and this can only be effected by the agency of two of the most important organs in the animal body, namely, the heart and lungs.

Under this explanation, we are prepared to observe, that the chyle, or newly formed fluid, being received into, and conveyed by, the large returning vessels with the deteriorated blood which they contain, to the *right side* of the heart; the blood is forced by the muscular contraction of that organ into tubes that convey it to the lungs, upon the very fine, transparent, membranous surface of whose cells, these tubes or vessels ramify in every direction, so as to admit of the extrication of the injurious materials, and of the absorption from the atmosphere, of those particles, which render the blood fit for the purposes of nutrition. It is then conveyed back by another set of vessels, to the *left side* of the heart; which being distended, it contracts, and forces the blood into the several tubes or arteries which are to carry it to its ultimate destination; namely, to all the different parts of the body requiring a supply, and to the several glands from which the animal secretions are to be derived.

From this account, which applies to the more perfect animals, it appears, that the heart, the first organ concerned, must be double; that is, have two distinct parts, and corresponding vessels, each performing separate offices; the one to receive and convey the new, unorganized blood to the lungs; the other, to transmit the *perfected* fluid to the several parts of the body. That the lungs must be of a spungy texture to admit of a receptiou and application of air so effectually, as to answer the desired ends; and that the propelling vessels or arteries should be strong and muscular, to give an additional impulse to the circulation after the contraction of the heart has been completed. We have *here* then, a very wonderful apparatus to accomplish the most important operation in the animal economy; and as it must appear from this explanation, that the living principle is entirely dependent upon the agency of atmospherical air, and as we know it is instantly suspended upon the least interruption to its admission; it is most obvious that the greatest precaution was necessary against accidents, which, even only of momentary operation, might be instantly destructive to animal life.

We accordingly find, that while vegetables are made up of soft and fragile materials suitable to their functions, animals are composed of those which are strong and resisting; their most important organs, especially the heart and lungs, to which we now more particularly allude, being so effectually secured within a bony exterior, that no injury, short of extraordinary force, or some unusual impulse, could possibly reach them.

If we look more nicely into the structure and relative situation of those organs, we find the heart, whose cavities are liable to great distension, formed of a thick, muscular substance of sufficient flexibility, to admit of their being dilated without the risk of rupture, and protected by a strong, resisting bag, named the pericardium; while the whole is nearly enveloped by the lungs, which are also made of a very pliable nature, that they may not be injured by the constant action to which they are exposed. Thus the circulating and respiratory systems so important to animal existence, display a wonderful arrangement, in which security and effect are equally conspicuous; and which, by evincing the most benevolent attention to the welfare and preservation of the individuals upon whom it has been bestowed, is well deserving of your minuter investigation.

As the mechanism, upon which I have just treated, has a particular reference to the admission of air into the blood vessels; it is obvious that in those animals which can subsist upon a diminished supply of that fluid, a less complicated machinery might answer the required purpose. Nature, therefore, has made the proper distinction, by confining the double circulation and a warmer blood to those animals which are not only exposed to the common atmosphere and its peculiar temperature, but also to a very active use of their locomotive powers; as illustrated in our own species, land quadrupeds, birds, and in whales, the last of which are obliged to be frequently on the surface of the water for a fresh supply of air, and to expel the superfluous fluid imbibed by their lungs. While she has bestowed on others, a more simple apparatus, and blood of a lower temperature; as exemplified in the amphibia and common fishes, in which, from living principally in the water, where the element is cooler, and the air in diminished proportions, a single heart and a reduced caloric or heat has been sufficient: and more especially in the insect and worm tribes, where (as explained before) a still much less complicated mechanism has answered all the respiratory purposes required by those animals. In this arrangement, like every other in which nature has been concerned, we again see a wonderful adaptation of the means to the end; and that while the utmost precaution has been used to preserve the vital principle, no more capability of excitement has been given, than was necessary to answer the purposes required.

We come now to the organs of sense and voluntary motion, by which animals are principally distinguished from vegetables, and which, by the attributes they have conferred upon our own species, have elevated man very far indeed above every other part of the creation. Upon this interesting subject, my time will not allow me to do more than offer a few general observations; reserving a particular account of each organ of sense for a future lecture.

Sensation has philosophically been stated to consist of a consciousness of a change taking place in any particular part, from a contact of a foreign body with the extremities of the nerves: hence the seat of sensation is in the pulp of the nerves, and the brain, with which the nerves communicate, is the source of perception. Animals, therefore, to possess those attributes, must have a brain and nervous system. And such we find to be *directly* the case in all red blooded or more perfect animals; and, *indirectly*, presumed to exist in the other classes, and even in those where sensation only appears to be present, as in several of the lower orders of worms.

By the combined operation of perception and sensation, we find most animals endued with very wonderful properties; and acquire a versatility of movements which confer a peculiar interest on their species. Thus from the excitement of their *optical* organs, by the agency of that transparent matter named light, vision is produced; by which, with electric rapidity, they notice the objects which surround them, and by repetition, impress upon their memories the resemblance of each object, so as to discriminate it when again presented to their sight; and through the same agency, they can more or less comprehend the motives or feelings by which other living substances are influenced, and avoid or approach them as suits their convenience. By the action or vibration of the atmosphere upon another nerve, or more properly its membranous expansion, that of hearing, the sensation of sound is communicated to the brain, and by a repetition of this sensation, they learn to comprehend its varieties so as to increase their means of discriminating objects or events, by which they can still further recognize each other, or avoid danger upon its approach. By a third organ, that of smell, they possess a nerve, which is excited by the gas, or effluvia, of certain bodies produced by chemical agency or by natural evaporation, through which they can distinguish agreeable or disagreeable, injurious or salutary substances, and trace their enemies, or more readily pursue their prey. By the excitement of a fourth nerve, they acquire the attribute of taste, by which the selection of their food is regulated, and (as already explained) one of their principal enjoyments produced. And by a general expansion of nervous membrane over the whole of the extreme surface, namely the skin, they acquire the sense of common feeling, which conveys to them a consciousness of injury when any external part is unduly excited, and qualifies some of them to distinguish substances by the touch.

Independently of these five sources of sensation, most animals are made up of certain fleshy portions, called muscles, to which nerves, communicating directly or indirectly with the brain, have access. And these, by some unknown agency in the brain, can be called into action at the will of the individual; thus constituting what has been termed voluntary locomotion, or the power by which the animal can at pleasure move a particular part, or change its position, whether in search of food, to avoid danger, or for the purpose of more closely congregating with its species.

Thus nature, by these several attributes, has provided the animal kingdom with the means of discovering, and of avoiding danger; of feeling pain at one time which, while it adds to their security, contributes in a comparative degree to their pleasure at another; and of partaking through the medium of their senses, of a vast variety of gratifications that contribute to the enjoyment of their existence.

But these properties alone would not have qualified them to be useful, had they not been endued with some other principle by which their movements in all their respective varieties, might be regulated; and this principle, which, for the present we must denominate *intellect*, has been acquired by the various impressions which the frequent exercise of their organs of sense has made upon that seat of all sensation, *the brain;* which possessing (by means beyond all human comprehension) the property of concentrating the ordinary sensations, so as to give them one impulse, has enabled animals, in different degrees, to judge for themselves, and to act accordingly.

That many animals do possess, according to their several capacities, a *graduated* scale of reason, every observing person, we apprehend, must readily admit; and that they are endued with a greater portion of that noble faculty than is generally allowed, our own remarks upon their habits, lead us to consider as extremely probable; though in this acknowledgement, I am far from attributing animal actions to the mere influence of their reason; being fully aware that an instinctive impulse predominates in most animals, in which volition has little concern.

If I may be permitted to offer an opinion upon a subject on which philosophers are by no means decided; that is, to determine where instinct ends and reason begins; I should say that instinct is governed by one unvarying law to answer a definite end, namely, the production and preservation of the animal; that it never retrogrades to the right or to the left; but uniformly pursues its undeviating course, until the desired object be maintained. Reason, on the contrary, by which, (as applicable to the brute animal) I mean only perception leading to voluntary actions, is open to the casualties of circumstances, which may never occur to the animal, and therefore the actions arising therefrom, are fluctuating and precarious; but always produced from an impulse originating in a particular feeling, and consequently directed to an object corresponding with that impression. Hence the brute reason is more observable in domesticated animals, where education has in a certain degree called forth their intellect, than in those which are wild, in which the natural laws have been left to their full operation.

Under this view therefore, all the common propensities of animals, and all their usual and ordinary movements may be considered *instinctive;* since these are their natural attributes, and are so engrafted on the constitution, that no external circumstance can alter them; and it is only where there is a *choice* of action, (in which to produce it *the will* must be concerned,) that reason may be considered as having any share in the impulse. Thus the extreme ingenuity displayed by the bee, in collecting from the petals of flowers the honey which is to form its winter supply, and in constructing the cells for its reception, with that hexagonal and geometrical precision which, if executed by human hands, we should call invention of the first order; we denominate instinct; because it is throughout uniform in its operation and effect, is the peculiar attribute of the animal, and the process its constant occupation, upon which its existence altogether depends, and beyond which, it is not capable of extending its ingenuity.

The same opinion may be applied to the ant, to the spider, to the beaver, and to many other animals, which evince equal providence in collecting and laying by their provisions, as well as in forming their habitations; to birds, in their sexual attachments, in the construction of their nests, and in the time devoted to incubation or sitting on their eggs; and to animals in general, in the affection they shew for their offspring until they can provide for themselves, when they drive them away, and afterwards lose sight of them altogether. Even in *the human species*, in whom the attributes of reason are in general so predominant, an instinctive principle may be attributed in those instances, when the most anxious feelings of the mother are called forth for the new born infant, even before she has seen it; and which, without any former associations, or those circumstances that on other occasions awaken the affections, often supersede every consideration for her own sufferings or personal safety, to secure to her offspring, *at all risks*, the due care, protection, and requisite comforts. The same instinctive feeling, though no doubt increased by reflection, association, and those finer sentiments which emanate alone from the mind, and therefore may be considered of a mixed quality, may be observed to predominate more or less for many years after the birth of the child, and often far beyond the period in which her offspring might be considered competent to act for itself; and therefore, in this instance, instinct exceeds the boundary which nature has laid down for the brute species, and no doubt for very wise purposes; since human actions, in early life, are too often influenced by a fluctuating judgment, and therefore, if not occasionally regulated by parental admonition, might involve the individual in irreparable difficulties.

In the infant itself, the instinctive character is still more exquisitely marked. Its very first action, namely that of crying immediately after birth, is decidedly to be attributed to the impulse of instinct; since it is the natural consequence of the first admission of atmospherical air into the lungs, by which their excitement is called into action; and as its object is to promote their expansion, and as it is unconnected with any mental feeling, it is only to be considered a natural operation, in which reason can have no concern.

The early process on the part of the infant of taking its food (and which is applicable to all sucking animals) is also derived from the same source; since no choice is displayed, and the action can at any time be produced by the application of a substance that will excite the muscles of the tongue. The operation therefore is mechanical, and altogether unconnected with consciousness or voluntary motion.

The crying of children for some time subsequent to their birth, may also only be considered an instinctive expression of uneasiness or pain which nature has caused for the purpose of calling forth relief; and has no reference to those passions where the mind is more directly concerned, and in which, in other instances, the act of crying is one of the certain indications. But when the child begins to notice and discriminate the surrounding objects, and more especially when by its actions, it evinces a desire to come in contact with them, and shews disappointment in its attempts being opposed; here instinct begins to lose ground, and reason to assume its place; since there can be no discrimination without perception, and no desire to act, but through the medium of the will.

Adverting again to the brute species, there is a train of actions peculiar to animals, which though not powerfully bespeaking intellect, have, *in my opinion*, erroneously been attributed to instinct. Thus, when we see an animal which has frequently been conducted to a particular spot at some distance from home, and through intricate roads, after a certain period of practice, of itself find its way back; or when we observe that animals shall uniformly return three or four times a day at the accustomary hours to be fed; or as in the case of cows, at fixed periods to be milked; we should not call this instinct, but habit, from the exercise of the memory; an intermediate state between instinct and reason; since the practice depends upon accidental contingences, in which a small proportion of reason must be exercised, to carry them into effect. But if, on returning home, the animal on meeting roads of opposite directions, should stop to look about, and hesitate, as if dubious of the right, and then determine (as I have frequently noticed;) this we should call reflection, and if it be reflection, that attribute we know must emanate exclusively from reason.

To the influence of reason, I should also attribute the resentment often evinced by animals when under ill treatment from ourselves; the partiality and affection which they display towards us, when an uniform series of kindness and preference has been bestowed on them, and the jealousy they evince when that preference has been transferred to another; the recollection which they retain of punishments and rewards; and the corresponding actions produced therefrom; the evident influence on many of them, (but especially on the dog species) of the passions expressed in the human countenance and voice, whether of encouragement to approach, or threat of punishment, a command to retire or to move in a new direction, a dread of their attacks, or a look of determination to resist their threats. All these diversified effects, with a vast variety of others that might be enumerated, I consider to be the result of a certain portion of reason; since they are produced from unforeseen excitements not connected with the animal's existence and ordinary habits, and must be preceded by reflection, and followed by decision, before they can be called into action.

Thus we observe that nature has been wonderfully benevolent in its dispensations, in providing each individual, either through the medium of those innate properties which we denominate *instinct*, or through the superior agency of reason, with all those means of self-defence, enjoyment, and variability of movement, which, while they be fully calculated to answer the desired ends, confer a peculiar grace and dignity upon the kingdom to which each animal belongs; affording proofs the most irresistible of the omnipotence and wisdom of Him, by whom the animal world was first created and called into life and activity. And as by the aid of *our* superior reason, we have been entrusted directly or indirectly with the controul of every living substance of inferior attributes to our own; and as it is obvious that animals are not only endued with feeling like ourselves, but from perception also, are in very many instances alive to the treatment they receive from us, and to the affections and antipathies with which our conduct towards them is calculated to inspire; it becomes an imperious duty *on our part*, never to observe towards them unnecessary cruelty, or to make them the wanton subject of our sports and diversions. To treat with fostering care and unqualified humanity, those animals that we take immediately under our protection, whether for utility, or as domestic companions; and if it be requisite that their lives be sacrificed to our use, to take care that so violent an expedient never be wantonly exercised, and that it be executed in the speediest and most merciful manner that human ingenuity can suggest.

In taking this general view of the animal kingdom, we cannot but be struck with the utility the greater proportion of it has been made to confer upon the human species, and how comprehensively the particular existence and enjoyment of each individual, has been brought within the scale of Providence.

In every part of the world where man has fixed his residence, we find those animals most necessary to his support and accommodation, accompanying his progress, multiplying in proportion to his wants, and their quality adapted to the climate under which he lives. Thus, in tropical countries where a vegetable diet is better calculated for his constitution than a large proportion of animal food, we find vegetables and fruits in their highest perfection, abounding to a most luxurious degree; while the domestic animals are small in stature, and affording a diet less stimulating than in northerly countries, in which, from the increased tone of the digestive organs, and from the more active occupations of the inhabitants, substantial food is indispensable for his support.

In each situation, we find those quadruped animals, intended for the use of man, the least difficult to domesticate; and such as are immediately required for his personal accommodation and protection, the most intelligent, faithful, and affectionate.

In those countries, where, from the quality of the soil and the unkindness of the climate, great muscular exertion is requisite to render it productive, or where, from the occupations and pursuits of the inhabitants, much animal strength is necessary, as in the northerly parts of Europe and America; we see, in general, a race of animals of the horse and ox species endued with powers that, if called into action in hotter climates, would cause them to sink under the exertion; while, in tropical countries, where great muscular energy would incapacitate the animal for the climate, we see a diminutive race of the same species capable of performing all the requisite duties.

Under this view of the dispensations of Providence, we find in most parts of the world, where mankind has emigrated and become populous, the horse, the ox, and the sheep, (from which animals so many personal and general conveniences are derived,) to prevail; but those of different qualities, and varying considerably in their numbers, according to the climate in which their services are required. In mountainous districts, where pasturage is scanty, we find the goat most frequently to supersede the sheep and the cow; and there, from the intricacy and the precipitous state of the roads and passes peculiar to such districts, we observe the prevalence of a larger species of the ass tribe, the progenitor of the mule, whose invaluable services afford to man the facility of traversing countries, which, without them, he could not attempt but at the risk of his life. In certain parts of the world, where land carriage is interrupted by the unevenness of the country, or where from its great extent, long and harassing journies under a vertical sun are requisite to preserve a mutual intercourse with its remoter districts, as in many portions of Asia and Africa, we find the elephant and the camel to prevail; the former, the largest and most powerful of quadrupeds, the latter, next to the ass, the most docile and the easiest to subsist in situations where, from the scarcity of food and water, all other animals would inevitably perish. In no part of the world that we have made ourselves acquainted with, have been wanting (whether as companions, or as domestic servants of the very first utility,) the dog or the cat; and though the wild carnivorous animals, many of them so formidable in their aspect and sometimes in their actions, are occasionally destructive to the property and persons of individuals within their reach; yet even *these* are made subservient to human purposes, since they call forth the energies and ingenuity of man for their destruction; their skins, or some portion of their bodies, are often the subject of commercial transactions; and they are the direct means of keeping within due bounds a vast variety of the smaller animals, whose depredations in general, are more destructive and vexatious than even the encroachments of their own species, whose attacks are usually so much the cause of our apprehension.

Thus it appears, that the quadruped animals (to which we now more particularly allude,) have in most instances a reference to the wants, conveniences, and occupations of man—that they resemble him in many of their attributes, and in most of their physical properties—and that without *their* presence and aid, he would have been rendered nearly as useless and as helpless as on the day which first gave him birth.

We come now to a subject, no less interesting; the provision which nature has made for the animals *thus* devoted, so as to secure *to them also* a due share of protection and enjoyment, consistently with the sphere in which they are destined to move.

Although we may justly presume, that the great object of the creation in all its several parts, had principally in view the accommodation and pre-eminence of the human species; yet it would not have corresponded with the general benevolence which we *so justly* attribute to the supreme Being, had any part of it been allowed to be benefitted at the expense of the remainder; or, in other words, that one portion of the system should be exposed to great privations and sufferings, only to give a greater zest to the happiness and gratification of the other. So far from that being the case, we find a very ample arrangement has been made for the protection and enjoyment of the brute species, in every possible way, their particular nature may require; and that though it was not intended, nor was it necessary, that their happiness should be derived from those refined feelings which belong to the human species; yet if we come to draw a fair comparison between the relative sufferings and enjoyments of each, it may well be deserving of consideration, whether an inferiority on the one side, has not been amply balanced by the nicer sensibilities, and physical infirmities, of the other. Man is brought into the world more helpless than any other animal; without a covering to protect him against the weather, and hardly endued with one instinctive property to direct him to the source from which his subsistence is to be obtained. He is therefore indebted to the ingenuity and more than ordinary care of his own species for his immediate protection and support; and being endued with capabilities only, he can make no advance without the aid of instruction, nor afterwards succeed but by his own industry, or by the assistance of those with whom he associates. He is also longer than any other animal before his physical powers are fully developed; and before this be accomplished, he is liable to a variety of diseases, which tend to destroy him at an early period, or to lay the foundation for future maladies, that ultimately deprive him of life, or expose him to frequent suffering and pain for the remainder of his existence; independently of the ordinary casualties from sickness and accidents, to which, through his whole course, he is unavoidably exposed. And if to these drawbacks, we add those mental afflictions to which, from a variety of causes, he is so frequently liable, and from which, all other animals are exempt; we shall probably be ready to admit, that *his* superiority in the creation, and the *higher* degree of enjoyment of which he is susceptible, are very amply balanced by the sufferings to which he is exposed, and by the importance which he attaches to an existence, of the possession of which, his consciousness tells him, he cannot calculate for one hour; or when deprived of it, whether still greater sufferings may not await him, than those which he has left behind.

The brute species, on the contrary, are rendered by nature independent of the necessities of which man, from his physical construction and moral propensities, stands so uniformly in need. Most of them, when first brought into the world, or very soon after, are provided with a suitable covering to their bodies, acquire a free use of their limbs, and are endued with those *instinctive* propensities, which, at a very early period render them independent of foreign aid, and qualify them to perform all the animal purposes for which they were created. To select their food according to the demands of their appetite, or to the peculiarities of their constitution;—to defend themselves against their adversaries, and to protect and provide for their own offspring;—to retire at the proper hour and place to rest, and to leave their retirement when the business of the day is to commence. And if to this state of independence, we add their *total* exclusion from all mental anxiety or concern about the present or the future; the pleasure they derive from the gratification of their various appetites, and from the free exercise of their limbs, alternated as it is by sweet and uninterrupted repose; however a portion of them may be subjected to inconveniences from the caprice and cruelty of man, or their lives be subservient to his use; we may still consider their lot to be fairly balanced against our own; and that Providence, in its dispensations, has given to each individual, whether human or otherwise, an equal share of enjoyment and suffering proportionate to its capabilities, and to the purposes for which the world, in the divine wisdom, was originally created.

On the use to mankind of the other portions of the animal kingdom, we have also a very extensive scope for observation. But under my present limits, I can only remark, that though, from their structure and habits, the greater number of them is placed beyond the reach of human protection; they all act a most important part in the economy of nature, and by means highly interesting to the philosophic inquirer;—that very many of them supply us with some of the most useful articles of our food, and essentially contribute to our commerce;—and that, consistently with the limited duties which they have to perform, and in proportion to their respective capabilities, the same benevolent provision has been made for their gratifications and continuance, which has been conferred upon every other part of the animal creation.

OUTLINE OF CUVIER'S CLASSIFICATION OF ANIMALS;

With examples of species belonging to each division.

Copied from Dr. Roget's introductory lecture on Human and comparative Physiology.

I. VERTEBRATA.

1. MAMMALIA.

Bimana . .	*Man,*
Quadrumana .	*Monkey, Ape, Lemur,*
Cheiroptera . .	*Bat, Colugo,*
Insectivora .	*Hedge-hog, Shrew, Mole.*
Plantigrada .	*Bear, Badger, Glutton.*
Digitigrada .	*Dog, Lion, Cat, Martin, Weasel, Otter.*
Amphibia .	*Seal, Walrus.*
Marsupialia .	*Opossum, Kanguroo.*
Rodentia .	*Beaver, Rat, Squirrel, Porcupine, Hare.*
Edentata .	*Sloth, Armadillo, Ant-eater, Pangolin*
Pachydermata	*Elephant, Hog, Rhinoceros, Tapir, Horse.*
Ruminantia -	*Camel, Musk, Deer, Giraffe, Antelope, Goat, Sheep, Ox.*
Cetacea . .	*Dolphin, Whale.*

2. AVES.

Accipitres .	*Vulture, Eagle, Owl,*
Passeres .	*Thrush, Swallow, Lark, Crow, Sparrow, Wren.*
Scansores .	*Woodpecker, Cuckow, Toucan, Parrot.*
Gallinæ .	*Peacock, Pheasant, Grouse, Pigeon.*
Grallæ . .	*Plover, Stork, Snipe, Ibis, Flamingo.*
Palmipedes .	*Auk, Grebe, Gull, Pelican, Swan, Duck.*

3. REPTILIA.

Chelonia . .	*Tortoise, Turtle.*
Sauria . .	*Crocodile, Lizard, Camelion*
Ophidia . .	*Serpents, Boa, Viper.*
Batrachia .	*Frog, Salamander, Proteus, Siren.*

4. PISCES.

Chondropterygii	*Lamprey, Shark, Ray, Sturgeon.*
Plectognathi .	*Sun-fish, Trunk-fish.*
Lophobranchi .	*Pipe-fish, Pegasus.*
Malacopterygii	*Salmon, Herring, Pike, Carp, Silurus, Cod, Sole, Remora, Eel.*
Acanthopterygii	*Perch, Mackarel, Sword-fish.*

II. MOLLUSCA.

Cephalopoda .	*Sepia, Nautilus.*
Pterepoda .	*Clio, Hyalæ.*
Casteropoda .	*Slug, Snail, Limpet.*
Acephala .	*Oyster, Muscle, Ascidia, Pyrosoma.*
Brachiopoda .	*Lingula, Terebutula.*
Cirrhopoda .	*Barnacle.*

III. ARTICULATA.

1. ANNELIDES, OR VERMES.

Tubicolæ .	*Serpula, Sabella.*
Dorsibranchiæ .	*Nereis, Aphrodite.*
Abranchiæ .	*Earth-worm, Leech.*

2. CRUSTACEA.

Decapoda .	*Crab, Lobster, Prawn.*
Stomapoda .	*Squill.*
Amphipoda .	*Gammarus.*
Isopoda . .	*Asellus*
Branchiopoda	*Monoculus.*

3. ARACHNIDA.

Pulmonalia .	*Spider, Scorpion.*
Trachealia .	*Phalangium, Mite.*

4. INSECTA.

Aptera . .	*Centipede, Podura.*
Coleoptera .	*Beetle, Glow-worm.*
Orthoptera .	*Grasshopper, Locust.*
Hemiptera .	*Fire-fly, Aphis.*
Neuroptera	*Dragon-fly, Ephemera.*
Hymenoptera	*Bee, Wasp, Ant.*
Lepidoptera .	*Butterfly, Moth,*
Rhidiptera .	*Xenos, Stylops.*
Diptera . .	*Gnat, House-fly.*

IV. ZOOPHYTA.

Echinodermata	*Starfish, Echinus.*
Entozoa .	*Fluke, Tœnia, Hydatid.*
Acalephæ . .	*Actinia, Medusa.*
Polypi .	*Hydra, Coralline, Pennatula, Sponge.*
Infusoria .	*Brachionus, Vibrio, Proteus, Monas.*

BLUMENBACH'S

CLASSIFICATION OF ANIMALS;

Extracted from that Author's Manual of Natural History, translated by Gore.

MAMMALIA.

ORDER

1. BIMANA.—Man with two hands.
2. QUADRUMANA.——Animals with four hands—apes, baboons, monkeys, and makis (Lemurs)
3. CHEIROPTERA.——Mammiferous animals, in which the fore feet form membranes for flying—bats.
4. DIGITATA.——Mammiferous animals with separate toes on all four feet. This order is divided, according to the differences of the teeth, into the following three families:—

   (A.) *Glires.*—With teeth like those of the mouse, as the squirrel, dormouse, and other mice; the marmot, guinea pig, jerboa, hare. porcupine.

   (B.) *Feræ.*—Carnivorous animals, properly so called, and some other genera, with teeth of the same kind—lions, dogs, &c., the bear, weasel, civet, opossum, hedgehog, shrew, mole.

   (C.) *Bruta.*—Without teeth, or at least without fore-teeth, &c.—sloth, ant eaters, armadilloes, manis.
5. SOLIDUNCULA.——The horse, &c.
6. BISULCA.—Ruminating animals with cloven feet—the camel, the ox, the goat, the sheep, &c.
7 MULTUNGULA.—Mammiferous animals, for the most part very large, unshapely, with bristles of scattered hairs, with more than two toes on each foot—as swine (which have usually four toes,) the tapir, elephant, rhinoceros, hippopotamus.
8. PALMATA.——Mammiferous animals, with feet made for swimming; subdivided according to the different forms of their teeth, into three families, as above:—

   (A.) *Glires.*—The beaver.

   (B.) *Feræ.*—Seals, otters, &c.

   (C.) *Bruta.*—Duck-billed animals—walrus, manati; and from these the most suitable transition to order

ORDER

9. CETACEA.——Whales, warm-blooded animals, which have nothing in common with cold blooded fishes but the name; and the natural connexion of which, with mammifera, was correctly remarked even by Ray.

BIRDS.

A. LAND BIRDS.

1. ACCIPITRES.——Birds of prey; with strong hooked beaks, mostly with short, strong, knotty feet, and large, crooked, sharp claws—the vulture, the falcon, the owl.
2. LEVIROSTRES.——With short feet; and very large, thick, but mostly hollow, and therefore, light bills—parrots, toucans, &c.
3. PICI.——With short feet; moderately long and small bills, and the tongue sometimes worm-shaped, sometimes thread-like—the wry neck, woodpecker, creeper, humming bird, &c.
4. CORACES.——With short feet, and the bill moderately long, tolerably strong, and convex above—ravens, crows, &c.
5. PASSERES.——The singing birds, with swallows, &c. The feet short, the bill more or less conical, pointed, and of various length and thickness.
6. GALLINÆ.——Birds with short feet, the bill somewhat convex above, and having a fleshy membrane at the base—the pigeon, the partridge, the pheasant, the peacock, the common cock, &c.
7. STRUTHIONES.——Large land birds unsuited for flying—the ostrich, cassowary, and dodo.

(B) WATER BIRDS.

8. GRALLÆ.——Birds found in marshes with long feet; long, and almost cylindrical bills, and generally a long neck—the heron, the bittern, the plover, the rail, &c.
9. ANSERES.——Swimming birds with oar-like feet; a short bill covered with skin, generally serrated at the edge, and terminated at the extremity of the upper jaw by a little hook—the swan, goose, duck, and the various species of sea fowl.

AMPHIBIA.

1. REPTILES.——Amphibia with four feet—tortoises, frogs, lizards.
2. SERPENTES.——Serpents without any external organs of motion.

FISHES.

(A.) CARTILAGINOUS, WITHOUT TRUE BONES.

(B.) BONY FISHES—FISHES PROPERLY SO CALLED.

ORDER

(A.) 1. CHONDROPTERYGII.——Without an operculum, or covering of the gills—as the shark, the lamprey, the torpedo, the skate, the saw fish, &c.

(A.) 2. BRANCHIOSTEGI.—With an operculum.—the sturgeon, the globe fish, the sun fish, &c.

(B.) 3. APODES.——Without ventral fins—the eel, the sword fish, &c.

(B.) 4. JUGULARES.——Having the ventral in front of the pectoral fins—the haddock, the cod, the piper, &c.

(B.) 5. THORACICI.——Having the ventral immediately below the pectoral fins—the dory, the plaice, the flounder.

(B.) 6. ABDOMINALES.——Having the ventral behind the pectoral fins—the salmon, the trout, and most fresh water fish.

INSECTS.

1. COLEOPTERA.——Mostly with horny bodies—beetles.
2. HEMIPTERA.——With four wings, folded together crucically or longitudinally, hard for one half, and almost like parchment—the cock roach, the grasshopper.
3. LEPIDOPTERA.——With soft hairy bodies, and four expanded wings covered with coloured scales—butterflies.
4. NEUROPTERA.——With four transparent, net-shaped, or lattice-like wings—the ephemera or day fly, the water moth.
5. HYMENOPTERA.——With four transparent veined wings—the wasp, the bee, the ant.
6. DIPTERA.——Insects with two wings, (uncovered)—the gnat, the various species of flies.
7. APTERA.——Insects without wings—the spider, the scorpion, the crab, the flea.*

WORMS.

1. INTESTINA.——Long worms without any evident external organs of motion—common earth worms, human worms, &c.
2. MOLLUSCA.——Naked, soft worms, with visible, and often very numerous extremities—the slug, sea blubber, sea anemone, &c.

* In the above order of insects, Blumenbach has followed Linnæus.

ORDER

3. **TESTACEA.**——Animals inhabiting shells, and much resembling those of the preceding order—the barnacle, muscle, oyster, and most of the animals contained in the sea shells.
4. **CRUSTACEA.**——Animals having almost cartilaginous bodies; and in some cases, with a firm incalcareous crust—sea hedgehogs, sea stars, &c.
5. **CORRALLIA.**——Polypes and other zoophites inhabiting coral branches and similar structures.
6. **ZOOPHITA.**——Naked, plant-like animals, without any habitations; also the animalculæ of infusions.

LECTURE IV.

ON ANIMAL AND VEGETABLE POISONS.*

The advantages of studying natural history and chemistry in all their respective branches, in no instance perhaps can be more powerfully illustrated, than by pointing out the destructive influence upon the human frame of those substances in nature, or produced by art, denominated—*poisons*; and which are derived from the animal, the vegetable, and the mineral kingdoms. Man, at a very early period, must have become acquainted with the baneful effects of animal and vegetable poisons. To the first, he would unavoidably be liable, from accidentally being brought in contact with venomous animals, whose attacks he could not at all times elude; to the

* Having been prevented from following up my intention of giving a lecture on the mineral, as well as on the animal and vegetable poisons; I have endeavoured to supply the deficiency, by introducing at the termination of the second lecture on poisons, a synoptical table, in which those of the mineral kingdom have, I trust, been sufficiently noticed, to answer every practical purpose.

latter, from that spirit of investigation which urged him to discover new substances for the gratification of his taste or his appetite, in the prosecution of which, he would naturally give trial to such as were deleterious in their nature, in common with those that were wholesome and useful. Having thus far succeeded, he would still be exposed to accidents, from mistaking one substance for another, in those instances, where the external character of vegetables bore so near a resemblance, as not to admit of an easy discrimination.

Of mineral poisons he could know but little; as the various metals and their chemical changes by which a poisonous quality is imparted, were then only very partially understood; and the earths, the alkalies, and the acids (most of which, excepting in very limited proportions are inimical to the human frame), from being at that time but little used, were still further removed from his knowledge.

The more we become acquainted with those substances which have been denominated poisons, the more are we convinced (when properly applied), of their utility, either in the arts, in medicine, or in some instances as articles of food, of which I shall offer some practical illustrations when I come to treat on particular poisons; and although those from venomous animals, may, in some instances, be an exception to these observations, and the necessity of the animals, from which they are derived, may not be brought within our limited comprehension; yet we know that the weapons, by which they inflict their deadly wounds, are intended for their defence, and that, without them, their means of subsistence would no longer exist; while the horror, uniformly produced by venomous serpents, serves as a protection to the whole tribe.

But man was not satisfied in his earlier discoveries with the power of discriminating between that which was salubrious, and that which was injurious to his constitution; but he must go one step further, and ascertain how far these deleterious substances might be turned to his own account. He soon discovered, that if his life could be destroyed by their accidental operation, that of his enemies also could be taken away by an ingenious application of them, without much risk (as he supposed) of entailing upon himself the consequences of premeditated murder; or that, if wearied of life himself, he possessed the ready means of getting rid of the evil, without the horror, and (as he imagined) without the pain, attending the more ordinary modes of committing suicide.

Hence the origin of secret poisoning; which has been prevalent for time immemorial, and which has disgraced the annals of mankind more than the committal of those other numerous crimes to which man has at all times shewn himself so prone; and hence savage nations acquired the means of imparting to their weapons, a destructive character, which rendered them unfailingly mortal to those with whom they came in contact.

History informs us that secret poisoning, whether for self-destruction or the administering of poison to others for felonious purposes, is of great antiquity; and we have accordingly records of this diabolical practice being carried to very extraordinary lengths in Greece, Rome, Carthage, Persia, and in all the eastern nations then discovered. The means, which they adopted to effect their purpose, (if we can credit the accounts transmitted,) were cruel and vindictive in the extreme—a tedious and most painful death awaiting those who were thus to be sacrificed, and often when no suspicion was entertained of the cause by which their sufferings were produced or of the lingering event which was to follow.

In less ancient times, when the human mind had been enlightened by the beams of a most benevolent religion, it might have been expected that this detestable custom would have been completely exploded, or confined to a few isolated cases, in which the national character would not have been committed; but we find, that not two centuries ago, it was practised to a considerable amount in France, and in Italy; the French and Italian historians having noticed some very extraordinary modes adopted for the purpose, that were to produce their effects within any given period, whether short or distant, and in a manner, to which we hardly at this day know how to give credit.

In England, secret poisoning, though formerly much more frequent than at present, was at no period carried to the same length as appears to have taken place in the southern parts of Europe, in Asia, and in Africa; and the nations of Europe now are too active in detecting crimes, too decisive in their punishments, and (we hope we may add) too enlightened, to allow such a system to prevail to any considerable degree.

Thus, in the place of whole families being taken off by the secret administration of poison as formerly, we hear of only single instances of this offence being committed; and those comparatively of rare occurrence.

But if civilization has weakened those cruel propensities which distinguished the less refined periods of society; or if wise and vigorous regulations have kept them within ordinary bounds; yet still vice predominates in the human mind under a different form, though less glaring in its external character. It is true, in these improved times, we hear but of few instances of murder being committed through the agency of poison.

But when we take into consideration the various frauds which are practised by mercenary men for lucrative purposes, by introducing deleterious substances into all the articles of life, and the slow but certain destruction of health which is thereby produced, we may perhaps have but little reason to rejoice at the exchange; more especially as the delinquents are placed less within the reach of detection, than when more decided violence has been committed, and the operation of these, their detestable practices, are more extensive and general, than where active poison has been administered from motives of personal gratification.

With respect to the mode of operation on the animal frame of the several poisons, each species produces effects peculiar to itself, and therefore requires a separate treatment.

The poison, from a venomous animal, operates only when introduced directly into the blood vessels; becoming, when received into the stomach, inert and no longer deleterious. Its effects, however, when once it reaches the system, are of a much more general nature than those of other poisons, and when derived from particular animals, are most frequently beyond the reach of medicine.

The other two poisons, the vegetable and the mineral, act with the greatest force upon being taken into the stomach; the vegetable poisons, in that case, with some few exceptions, injuring principally the brain and nervous system; and the mineral, the internal parts to which they are immediately applied, and more remotely, the distant organs.

There is another class of poisons which may be derived from any of the three kingdoms separately, or in combination, that produce their effects only through the medium of the lungs; and these have been denominated the *gaseous* poisons, which we shall notice in another place; confining our observations for the present, to those which act upon the system through the medium of the blood vessels and of the stomach; commencing with the *animal* poisons.

Animal poisons may be divided into three classes.—First, those which are introduced into the system by the bite or sting of some venomous animal. Secondly, certain animal subtances, which, received into the stomach, produce poisonous effcets. And, thirdly, contagious poisons, as the plague, contagious fever, small pox, and the like; a history of which, as belonging more especially to the province of medicine, we shall omit in these lectures.

In treating of venomous animals, it is not my intention to give an account of each species, or to enter into a particular history of their structure and economy. This would be foreign to my present plan, and would serve to throw no light upon the subject I have in view, viz.—an illustration of the different poisons, and of their effects upon the human frame. And as the nature of venomous poisons, excepting from the bite of a rabid animal, is nearly the same in all, and as their effects on the constitution differ only in degree; it will be sufficient to notice a few of those animals of each climate which are considered to be the most dangerous; to mark out their external characters by which they are to be distinguished from animals of the same class, which experience has taught are innocuous; and to describe the apparatus and mechanism of the instrument by which the poison is prepared and carried into the system, when they inflict a wound upon other animals.

Venomous animals, if we except those which are rendered accidentally rabid, are confined to the serpent and insect tribes; and of these tribes, very few belong to the former class.

Unfortunate, indeed, would it have been for mankind, and for the whole of the animal species, had quadrupeds and birds possessed in common with reptiles and insects, the power of destroying life by the same means which now obtain in venomous animals. In that case, man's whole life must have been devoted to the guarding against their attacks; and personal security and self-confidence would have been at an end. But in this, as in every thing else, Providence has wisely and humanely ordered it otherwise. For we find that this mode of defence is not only confined to two species, serpents and insects, both of which fly at the approach of man, and only attack when escape becomes impracticable; but that out of two hundred and thirty species of serpents, not forty have been found to possess poisonous fangs, and that of the bites of these, not twelve are fatal. While that of the insect tribe, the proportion of innocuous, to those which are offensive, is still much greater.

Of the venomous serpents, the rattle snake of America, and the cobra de capella of India are the most formidable out of Europe; while the viper, which, compared with the former, is of little import, is the only European serpent which bears a venomous character; and the latter animal is annually so diminishing in numbers, that its complete extinction may be calculated on at no very distant period. Climate, we know, has a great influence in the production and increase of reptiles of every kind, as well as in imparting activity to the poison peculiar to venomous animals; and from this circumstance, we can readily comprehend, why the most formidable animals are to be met with in the warmest latitudes. But it is well understood, if any credit can be given to historians, that ancient Europe was infested with serpents, both in number and character, of which we hear nothing at the present day; and the common viper, we know, is annually on the decline. We must, therefore, look for some other cause, independently of climate, for this fortunate change in the natural history of Europe; and we shall probably find it in the advance of cultivation and agriculture peculiar to modern Europe, and to this country in particular, by which impenetrable forests and woods, that afforded shelter to, and nurtured such animals, have been cut down and cleared; extensive swamps, in which they were also to be found, have been drained; and the haunts of venomous reptiles have, in every direction, been disturbed or destroyed by the hands of the cultivator.

Though venomous serpents differ from each other in magnitude, and in some of their external characters; yet they all possess in common, certain leading features by which they may be distinguished from the other classes which are not poisonous.

In the venomous, the head is flattened, scaly, and large in proportion to the body; the snout is rather broad; the neck is thick; the skin is of a dirty hue, and less variegated in its colour; and the body does not taper towards the tail in so fine a point. But the leading feature of discrimination is in the formation of the upper jaw; the venomous serpent having two, or more fangs attached to it, projecting out on each side beyond the other teeth, with which they inflict their poisonous wounds.

These fangs have, at their base in the upper jaw, a very small sac or bag immediately attached, which serves as a receptacle to the poison that has been secreted by a glandular apparatus, situated at the back part of the head, and behind each ear, and which, by means of tubes or canals running through the roof of the mouth, is conveyed into the sac to be ready for use. The fang itself, to which the sac is attached, is tubular; having an orifice on its outward extremity large enough to admit of the fluid being ejected by the pressure of the surrounding muscles, when the animal is excited to bite.

The poison contained in the bag, is a yellowish, viscid, tasteless liquid, very small in quantity, which, injected into the blood vessels, proves frequently fatal; but which may be taken into the mouth and stomach without any danger. Indeed it is a common practice with the viper catchers, to suck the wound when the bite has been inflicted; and we have witnessed the same practice in the West Indies among the negroes when bitten by any venomous animal.

When the sac is ruptured, (as may be effected by drawing the teeth of the animal,) the power of poisoning is destroyed; and of this, the viper catchers avail themselves, by irritating the animal to seize a piece of cloth, which the viper grasps so closely, as easily to admit of the tooth being extracted.

In Bingley's Animal Biography, the name of a gentleman is mentioned, who saw a rattle snake in which the fangs had been extracted, that was so completely tamed, "that it would turn its back to be scratched with the same delight, that a cat displays when rubbed before a fire; and would answer to the calls of the boys, and follow them like any other domesticated animal." In the same manner, the cobra de capella is tamed in India, and the viper in this country.

The flesh of all these animals, so far from being poisonous, is extremely nutritive; and among savage nations, is considered a great delicacy. "The American Indians regale on the rattle snake, and cook it as we do eels; and the peccary, the vulture, and other ravenous birds feed on its flesh." The negroes in the West Indies often make snakes a part of their diet; and the use of the viper has long been well understood in this country.

The *Crotalus,* or *Rattle Snake,* is peculiar to America, and is found in almost every part of it, from the Straits of Magellan to Lake Champlain on the borders of Canada. It reaches its greatest magnitude however, and assumes its most virulent character, in the warmer American latitudes; where humidity mostly prevails, and where cultivation has made the least progress. It is distinguished from other serpents, by the number of its scales on the abdomen and the under surface of its tail; in having a double set of poisonous fangs; and by the tail terminating in a large scaly appendage, consisting of several articulated horny processes, which move and make a rattling noise.

The rattle snake is divided into five species, each differing in their external character, size, and malignancy; of which the *crotalus horridus* is by far the largest and most formidable. They are all, like the viper, viviparous; that is, they produce their young alive and completely formed, generally about twelve in number; and like that animal also, they receive them into their mouth, when alarmed or threatened with danger.

The *Crotalus Horridus*, or *bandied Rattle Snake*, is from five to eight feet in length, and its body is about the circumference of the human arm; the back being of an orange tawny mixed with blue; the belly of an ash colour inclining to the aspect of lead; while the head is distinguished by a scale, hanging like a pent-house over each eye. But the most curious part of its external conformation, is its tail, from which the animal derives its name. This consists of a kind of rattle, formed of a certain number of loosely connected joints or articulations, commencing when the animal is about three years old, and adding one each succeeding year; so that they generally judge of its age, by the number of articulations of its tail, which, in some instances, have amounted to nearly forty.

This apparatus, when taken from the tail, bears a resemblance to the curb chain of a bridle, and is composed of a certain number of thin, hard, hollow bones, loosely connected to each other; so that when the animal shakes its tail (which it always does when irritated and alarmed,) it produces a noise like a rattle. As this is to be heard at a considerable distance, it affords time for escape to those animals that otherwise might be in the greatest danger from its approach. This animal, however, never inflicts a wound upon man, excepting when trodden upon, or irritated; but, on the contrary, flies from his advance whenever he finds the least chance of escaping; and when we add to this circumstance, the precautions observed by the inhabitants, when engaged in the woods where these animals prevail; it will easily be understood, why wounds, from the bite of a rattle snake, are not of very frequent occurrence.

When, however, the animal is accidentally or intentionally irritated, it immediately throws itself into a circle, pushes back its head, and, with great rapidity and violence, injects its deadly poison into the object of its vengeance; and according to the degree of irritation, repeats its attack as often as its strength will allow.

The bite, at first, resembles the sting of the wasp or bee; but the parts rapidly swell, become livid, and extend to the body and head, followed by delirium, fainting fits, convulsions, general swelling and discoloration of the body, and death; which takes place, in some instances, in three hours after the bite has been inflicted; at other times, at more distant periods; and if the weather has not been extremely hot, or the animal much enraged, the wounded man has a distant chance of recovery.

The unfortunate carpenter, who, in consequence of irritating a rattle snake belonging to Wombwell's menagerie, was bitten in September, 1809, by one of these animals, survived the bite fourteen days; when, after the unavailing efforts of the best medical advice, and after suffering extreme torture, he fell a sacrifice to his indiscretion early in the following October.

This tardiness in the operation of the rattle snake poison, may be attributed to climate; as we know that the whole of the snake tribe become torpid as the winter approaches, and that they increase in power and activity upon the temperature of the atmosphere advancing, when their bites become in proportion formidable and dangerous. Much also may depend upon a large blood-vessel being wounded, or only one of its extreme branches; the poison, in the former instance, being conveyed more rapidly into the system than in the latter, when there may be time for its being so diluted as considerably to weaken its efficacy. This observation will apply to the bites of all venomous animals; and it will serve to explain, why we sometimes hear of very rapid effects being produced by treatment, and at other times, why the patient recovers even without the trial of any remedy.

In Mr. Bingley's Animal Biography, we read of several experiments made with the poison of the rattle snake upon the dog species, as well as upon the body of the animal itself; by which it appears, "that a cur dog died from the bite of a rattle snake in a quarter of a minute; another dog, which was bit in the ear, survived two hours; and two other dogs, as large as our bull dogs, which were bitten in the thigh, one died in half a minute, and the other in four minutes; the first having received a wound in the inside, and the other on the outside of the thigh; while the animal, by irritation, was made to bite itself, and died in ten minutes afterwards. The snake was then cut into five pieces, which successively were devoured by a hog, without receiving any injury in consequence."

The same gentleman also related a circumstance, which strongly evinces the great activity of the rattle snake poison.

"An American farmer was one day mowing with his negroes, when he by chance trod on a rattle snake, that immediately turned upon him and bit his boot. At night, when he went to bed, he was attacked with sickness; he swelled, and before a physician could be called in, he died. All his neighbours were surprised at the suddenness of his death; but the corpse was buried without examination. A few days after, one of his sons put on his father's boots, and at night when he pulled them off, he was seized with the same symptoms, and died on the following morning. At the sale of the effects, a neighbour purchased the boots; and on putting them on, experienced the like dreadful symptoms with the father and son. A skilful physician, however, being sent for, who had heard of the preceding affair, suspected the cause; and by applying proper remedies recovered the patient. The fatal boots were now examined, and the two fangs of the snake were discovered to have been left in the leather with the poison bladder adhering to them. They had penetrated entirely through; and both the father, the son, and the purchaser of the boots, had imperceptibly scratched themselves with their points on pulling them off."

The *Cobra de Capello*, or *Hooded Serpent*, to which are given the different appellations of coluber naja, spectacle serpent, and the like, is a native of the East Indies, and of South America; and is still a more formidable animal than the rattle snake; as its bite is stated to be followed by certain and speedy death. A near relation of mine, who has passed many years in India, informed me that he has been witness to three persons being killed in seven minutes from its bite; and we have other instances of the rapidity of this most destructive poison when received into the human frame—a circumstance not to be wondered at, when we take into consideration the heat of the country of which it is a native; though the effects of the poison, like that of the rattle snake, will no doubt be varied by season, and by the manner in which the bite be inflicted.

This animal is from three to six feet in length, and about four inches in circumference. Its head is smaller in proportion to its body, than either the rattle snake or the viper; having on its neck, a tumor or loose mass of integument, flat and covered with scales, and on the top of it, a very conspicuous patch, resembling a pair of spectacles. Its colour is a pale rusty brown, and beneath, a bluish white tinged with yellow—the tail, unlike the other serpents described, tapering to a slender sharply pointed extremity. Its eyes are peculiarly shining, fierce, and bright. Its fangs, with which it inflicts its deadly wound, are placed in the upper jaw, and their mechanism is the same as that of other venomous serpents. Like them it retreats before human pursuit; but, when irritated, it is much more active in its movements, and more decided in its attacks. When preparing to assail its enemy, the body is erected, the head is bent down so as to admit of the integuments of the neck being extended over it in the form of a hood or cloak, from whence it derives its name; when, opening its mouth, and exhibiting its poisonous fangs, it springs on its enemy with the greatest agility and effect. Its bites, we have already stated, have a most deadly tendency, which has been fully illustrated by Mr. Boag, in the New Annual Register for 1800; though, from the causes we have noticed, instances are not wanting of persons recovering from them without the aid of any remedy.

The greatest enemy to this serpent is the ichneumon, or mangoose weasel, which feeds upon snakes and other reptiles. When the ichneumon falls in with the cobra de capello, the former takes every opportunity of provoking the first attack; placing himself in an attitude the most favourable to slip on one side and seize the head of his antagonist, which most frequently produces instant death. But if it fail, he bites the animal's tail to make him rise again, when the second seizure generally proves successful. If bitten by the serpent, the weasel sucks the poison from the wound, and feeds upon a herb which, in India, is considered to be an antidote; and thus escapes altogether the mortal effects which other animals uniformly experience from the bite of this very formidable serpent.

The poison, both of the rattle snake and of the cobra de capello, is collected and preserved by the untutored Indians for the purpose of arming their arrows; and the consequences of the wounds they inflict, from an instrument so destructive, may be easily anticipated. The food of these snakes is confined to birds, and to small animals.

There are many other poisonous serpents of a very dangerous character to be met with in America, in Africa, and in the East and West Indies; but as the two, we have noticed, may be considered the most formidable, we have thought it sufficient to confine our observations to them; more particularly as the symptoms which follow the bites of all such venomous animals, appear to be much the same, differing only in degree and consequences.

Pain, swelling, discoloration of the parts affected; an extension of these symptoms to those parts through which the poison has to pass on its way to the system, and an enlargement and discoloration of the whole body; a small quick pulse, fainting fits, vomiting, jaundice, delirium, hiccup, and convulsions close the scene, and mark the fatal issue in those cases where speedy relief has not been obtained, or where the natural resources of the constitution are not sufficient to resist the morbid effects of the poison.

With respect to the treatment of these most formidable symptoms, when produced by the bite of the rattle snake, the cobra de capello, and of other foreign serpents, without experience, we can have little to offer but conjecture. From analogy, we should be disposed to treat them upon the same principle as we know to be successful in the bite of the viper—the only venomous serpent to be met with in our country; and which, if followed up with vigour and perseverance, we should entertain very little doubt of success.

We are told of a variety of remedies, however, that are used in countries where these animals prevail; but these are so opposite in their nature and tendency, that we hardly know how to attach importance to their efficacy.

The serpentarii, or virginian snake root, and the seneka, or rattle snake root, are each used topically in the form of poultices, and given internally; and have had the reputation in America of curing the bite of the rattle snake and of other American serpents. And the head of the animal bruised and laid upon the part affected, as well as the topical application of a paste prepared by the Indians, to which they have given the appellation of snake-stone, are also reputed specifics in such cases; but we fear the efficacy of each is entitled to but little credit. If applications can be of any avail in casualties so desperate, assiduous frictions of unctuous substances, but particularly of olive oil, or of equal parts of laudanum and volatile alkali over the parts affected, and full doses of carbonate of ammonia conjoined with antispasmodics administered internally and frequently repeated, from their uniform success in the bite of the viper, appear to be well calculated to produce good effects, and are therefore well worthy of trial.

Dr. Orfila, a French author, who has published a valuable treatise on poisons, has recommended the application of a ligature above the wounded part, so as to check the returning blood to the heart, without stopping the circulation; and then to apply caustics, so as to destroy deeply the whole of the surrounding parts. His internal remedies are volatile alkali, wine, and active diaphoretics.

In the second volume of the Medico Chirurgical Transactions, Mr. Ireland, then surgeon to the 60th. regiment, has given an account of four cases in which arsenic had been successfully administered internally for some very desperate bites from the *Colubar Carinatus*, a most venomous serpent, peculiar to the Island of St. Lucia, in the West Indies; and from whose bites, an officer and several men belonging to the 68th. regiment, had some months before fallen a sacrifice.

In the four successful cases to which he has alluded, from the flesh being much torn by the bites, he removed the rugged edges of the integuments, and administered two drachms of Fowler's solution, (which is equal to one grain of arsenic,) in a draught composed of peppermint water and ten drops of laudanum; to which, when taken, half an ounce of lime juice was added, to produce the effervescent effect; and this was repeated every half hour for four successive hours; the parts being frequently fomented and rubbed with a liniment, composed of half an ounce of oil of turpentine, and an ounce and a half of olive oil. In a few days the patients recovered, and returned to their duty. He succeeded in another case at Martinique, where the patient was bitten by a serpent, reported to be as venomous and fatal as that at St. Lucia.

Mr. Boag, who has had some experience in the bites of the cobra de capello, recommends a weak solution of the nitrate of silver to be assiduously applied to the part, and small doses of it to be given internally. Should, however, future experience decide upon the inefficacy of all these remedies; in that case, the only security against the consequences of wounds so alarming, (if security is to be obtained,) would be a very deep extirpation of the surrounding parts, or the rapid extinction of the vital principle in them by the most active caustics.

The viper of Europe is the next venomous serpent for consideration.

This animal is peculiarly distinguished for its tenacity of life, and for bearing an abstinence from food for many months without being materially injured. The former is illustrated by Dr. Houlston, in his Treatise on Poisons, wherein he mentions, " that he placed a viper in the lowest part of the Grotto del Cana, near Naples, which is distinguished for its giving out the carbonic acid gas, or fixed air, well known to be fatal to all animals brought within its influence. The viper soon shewed manifest signs of being incommoded. It endeavoured to get to the walls, and being prevented, raised up its head as high as it was able, opened its jaws wide, seeming to gasp for breath, and after remaining *nine* minutes, became motionless; but thrown into the open air, soon recovered its former activity and vigour. In this cave, a dog is killed in four minutes, and smaller animals almost instantaneously." As a proof of its long retention of life without food, we need only advert to the practice of the viper catchers, who confine the serpents in boxes for weeks, if not months together, without supplying them with nourishment.

The *Coluber Berus*, or *Common Viper*, seldom exceeds in length two, though occasionally they have been found as long as three or four, feet. Their circumference, in their thickest part, may be considered something less than an inch. They possess two poisonous fangs on each side in the upper jaw, and an apparatus for preparing the poison exactly similar to that of the rattle snake and cobra de capello already described; and like them, they are viviparous, that is, they produce their young alive contrary to the common innocuous serpents, which are oviparous; the latter depositing their eggs in warm sheltered situations to be afterwards hatched by the sun, and this forms a leading discrimination between the two descriptions of serpents. The other distinguishing marks, are the form of the head, of the jaw bone, and of the teeth, the shape of the body and tail, and colour of the skin. The head of the viper is large in proportion to the body, and of rather a triangular form, the apex or snout being more flattened than the common snake. The jaw bone is also different: in the upper jaw of the viper, there are only two rows of common teeth, but from these, two poisonous fangs hang out, which are their principal instruments of attack and defence; while the innocuous serpent has no fangs, their place being supplied by three rows of teeth in the upper jaw, of which they make the same use as other animals; —by merely biting their prey without poisoning it. In the viper, the body is shorter in proportion, and it does not taper off towards the tail in that fine point which is a leading feature in the common serpent; by which it may be always known from those that are venomous. The colour of the skin is also another mark of discrimination; that of the viper consisting of a very dirty brownish yellow, being marked on the back by black rhomboidal spots, and on the sides by triangular ones, which uniting form upon the belly, one black surface; while the skins of the common snake, are often vivid in the extreme, very variegated, and frequently distinguished by beautiful stripes.

Though the viper is partial to a dry, stony, or chalky soil, yet it is occasionally to be met with in all soils and situations which affords it a slight shelter; its motions being much slower than the common snake. It lives principally upon insects and small birds; and never attacks larger animals but when trodden upon, or irritated. Like the rattle snake, the female receives its young ones into its mouth upon the approach of an enemy; and it is surprising what a number it will accommodate in this way, when its offspring is in danger. The ancient inhabitants of Europe collected the poison of the viper for the purpose of arming their arrows, when called upon by necessity to oppose the common enemy, or when urged by ambition or by revenge to make an attack upon their neighbours; as is the practice now among savage nations of other countries, in whom cruelty is considered no crime, and revenge one of the sweetest attributes of nature. Fortunately at the present day, Europe is more enlightened; and had the propensity continued, the means of indulgence have been so gradually diminished by the advance of agriculture and general cultivation, that the only venomous serpents to which we are exposed, will in a few years become extinct.

The flesh of the viper, from containing a large proportion of gelatine, was formerly in great reputation for pulmonary consumption, and for other diseases in which a restorative diet of easy assimilation was considered of use. Why it came to fail in the first most fatal of all maladies, no physician of any experience will be at a loss to decide. But that it should not be adopted in other diseases of debility which admit of being alleviated by a very nutritive diet, is a circumstance which can only be attributed to the caprice and uncertainty of all human practices, from which it could not be expected that our profession, enlightened as we must admit it to be, should be altogether exempt.

The viper, like the rattle snake and other venomous serpents, seldom makes its attacks upon man unless irritated by pressure or some other cause. Their bite, as to its depth and repetition, will be regulated by the degree of irritation, by the season of the year, and by the state of the health of the animal. The effects, in consequence, vary much in different individuals. Should the bite be confined to the external branches of the arteries, though severe, it is probable, the effects will be local only. Should it penetrate deeper, so as to wound a larger vessel, unless a remedy be speedily applied, the probability is, that the poison will reach the system, and produce a very distressing train of symptoms which in young subjects may terminate in death; a circumstance, however, not of very frequent occurrence in this, and in the other cooler latitudes of Europe.

The symptoms produced by the bite of the viper, are, in the first instance, similar to those occasioned by the sting of a wasp, or bee: the part becomes immediately inflamed, feels hot, is swollen and extremely painful. The colour of the affected part soon changes from a deep red, to a dirty yellow; which, with the swelling and pain, by degrees extend over a very considerable surface, following the course of the vessels towards the heart; and these symptoms, if not removed, are succeeded by fainting fits, a quick weak pulse, considerable nausea, bilious vomiting, and when it proves fatal, by jaundice, a swelling and livid appearance of the whole body, delirium, convulsions, and death. In the course of my practice, I have had an opportunity of seeing three persons who had been wounded by the viper, and these were all children.

In the two first, the local train of symptoms, though varying in each in degree, were so checked by the remedies applied, as to prevent the occurrence of what we have described as constituting the secondary symptoms. But in the third child, in consequence of very late application for assistance, the secondary symptoms (though ultimately removed by internal remedies,) had made great progress, and nearly terminated in the death of the patient.

The bite of the viper is to be treated upon the same principle as that of any other venomous serpent, as the effects in each differ only in degree. But as the viperine poison is much less active than that of the rattle snake, or the cobra de capello, we need not have recourse to those violent remedies, which according to our present view of the subject, we consider to be necessary in the other instances.

The viper catchers find a perfect security, when bitten, in an assiduous application of the fat of the animal to the part affected; a proportion of which they always keep in readiness against such accidents. This has led to the successful trial of olive oil warmed, so as to be readily absorbed by the wound, which is to be rubbed over the whole of the surrounding surface, until ease be obtained, and the swelling and inflammation have subsided; or until the patient can be considered to be completely out of danger. This remedy, when applied in time, has been never known to fail. We may, however mention, that equal parts of liquid volatile alkali and laudanum, and the eau de luce or volatile spirits of amber, have each been used, as we understand, with success; and that Dr. Orfila, in his Treatise on Poisons, recommends one part of liquid volatile alkali to be added to two parts of olive oil, and to be applied to the part affected in similar accidents. Should the disease advance, and the secondary symptoms supervene, then these applications are to be extended over the whole body; and the volatile alkali combined with the oil of amber, the eau de luce, or some other powerful antispasmodic, is to be speedily administered internally, assisted by wine, and by every means that will support the system, determine to the skin, and keep up the action of the vessels.

In the worst case to which we have alluded as coming under my own observation, the carbonate of ammonia in a draught combined with the oil of amber (of which ten grains of the former and ten drops of the latter may be considered a dose for an adult,) was administered every four or six hours as circumstances indicated. The effect was a profuse perspiration, and a speedy relief of the most distressing symptoms.

The celebrated Fontana, who has directed so much of his attention to the natural history of venomous animals, has presented us with a variety of experiments to prove, that the poison of the viper and of other venomous serpents, is neither an acid, an alkali, an astringent, nor a neutral salt; but an animal gum resembling in its neutral and chemical properties the common gum arabic. But as the latter gum, when applied to a wound, is perfectly inoffensive, the poison must possess some secret property that imparts to it the power of destroying the vital principle, which this philosopher has not yet discovered. He further states, that if rubbed on the tongue, within the lips, over the internal membrane of the nostril, or even on the external coat of the eye, the poison produces no irritation or bad effect whatever; and that it may be swallowed in pretty large proportions with perfect impunity; but that applied to the slightest scratch or wound, imflammation immediately succeeds, and the system is rapidly affected. That it proves fatal, not by increased action of the arterial circulation, but by destroying the irritability of the muscular fibre, and disposing both solids and fluids to a rapid decomposition.

We come now to the consideration of venomous insects, of which I shall select a few of the most offensive in foreign countries, and conclude with those that are more familiarly known to us at home.

The *Tarantula*, of the fatal effects of whose poison, and of the influence of music in the cure, so much has been said, is of the spider tribe, possessing, in most particulars, all the characters peculiar to that species of insect. It is a native of Italy, Cyprus, Barbary, and the East Indies: in the two former countries credulity on the one hand, and imposition on the other, have given it a quality which it does not merit; viz. the power of destroying human life by its bite, unless timely prevented by the most fascinating music. Accordingly, travellers in those countries have furnished us with a number of amusing anecdotes, strongly illustrative of the effects of superstition on the human mind, when unenlightened by the beams of science, or where tradition has closed the door to reason and the most obvious conviction. These anecdotes, which must be familiar to every reading person, we do not deem necessary here to detail; but shall merely observe, that the bite of the tarantula is never inflicted but when accidentally irritated; and though it always produces most severe pain, swelling, and discoloration of the part, and in constitutions of particular irritability, fainting fits, spasmodic affections, and even convulsions; yet it has in no instance, within my experience, (founded upon a four years' residence in the south part of Europe and in Barbary,) proved fatal; nor could I learn from others, that such an effect was ever produced; the symptoms being readily removed by the remedies, which I shall hereafter describe as being efficacious in the bites or stings of other venomous insects.

This animal, which, like other spiders, is made up of two divisions united by a slender thread, the one consisting of the head and breast, the other of the belly, rather exceeds an inch in length, and is of an ash colour on its breast, belly, and legs, and underneath is distinguished by blackish rings. It has eight legs united like that of a lobster; and eight eyes, two of which are red, are larger than the others, and are placed in front; four others are placed transversely towards the mouth; the other two are nearer the back. This number of eyes seems necessary in an animal whose existence depends upon its activity and vigilance; and particularly as the eyes are immoveable in the socket, and therefore cannot, when required, turn in different directions.

Its poisonous mechanism consists of two nippers or fangs on the fore part of the head with strong points, toothed like a saw, and terminating in claws like those of a cat. A little below the point of the claw, there is a small hole through which the animal emits the poison; and from this apparatus, its means of attack and defence are derived.

It is stated to prefer the bare fields for its haunts, where the lands are fallow; but I have seen it near houses, and within the yards, and sometimes even in the adjoining apartments.

According to Bingley, it lays between seven and eight hundred eggs, which are hatched in the spring; the parents being very short-lived, and seldom surviving the winter. Like other spiders, it makes a net or wall round its dwelling, which is generally about four inches deep in the ground, and half an inch wide.

All the spider tribes possess poisonous fangs, with which they kill their prey; and in South America, some of the species are very large and appaling in their aspect, and will destroy even small birds. But with the exception of the tarantula, the bite of the spider has little or no effect on the human constitution; though its external appearance, and the prejudices of early education, have stamped on it a character for virulence, which it does not merit.

The *Scorpion* is an animal of a very different description from the tarantula; it bearing a nearer resemblance to a very small lobster, or river cray fish, than to any other of the insect tribe, most of which it exceeds in size and virulence.

This animal is to be met with in southern Europe, the opposite coast of Barbary and other parts of Africa, and in the East and West Indies; its haunts being principally about old buildings, or under detached bricks and stones. It occasionally makes its way into inhabited houses, which renders their inmates liable to accidents of a very painful and troublesome nature, though they very rarely end with the loss of life. The leading external character of the scorpion, is eight legs, two claws resembling those of the crab, four eyes, a head as it were jointed to the breast, and a tail composed of six joints, which are bristly and appear like globules; the last joint being armed with a crooked sting, the fatal intrument that renders this animal so formidable. The sting is long, pointed, hard, and hollow. It is pierced near the base by two small holes, through which, when the animal stings, it ejects a drop of poison, which is white, caustic, and powerfully active. It is very impatient under confinement, and extremely irritable; so that the least touch will cause it to sting the offending substance with its whole force. It is also naturally bold and watchful, and seldom retreats from its enemy; but with its tail erect, and sting in readiness, it waits an attack with courage and intrepidity; and if not destroyed in the conflict, rarely desists, until it has killed its enemy, or put it to flight. The Scorpion, according to Mr. Bingley, in the East Indies, is sometimes a foot in length, and as bulky as a lobster; and concealing itself under the furniture, it renders a removal of articles of that description a matter of some danger.

The *Scolopendra* or *Centipede*, so denominated from possessing a number of legs, is a native of the East and West Indies, and of various parts of Africa, and, next to the scorpion, is the most venomous in the insect tribe; inhabiting chiefly the woods, where it is preyed upon by the different species of snakes. It is, however, to be found sometimes under pieces of stone, or within hollow pieces of wood, and even in houses; and is said to be so common in particular districts, as to oblige the inhabitants to have the feet of their bedsteads placed in vessels of water, to prevent their being annoyed during the night by these offensive animals.

Its colour varies from a reddish brown to a livid yellow, tinged with red; its body being long, depressed, and consisting of numerous transverse segments, on each side of which there is a leg; so that there are as many legs on each side as there are segments.

Its length varies from three to six or eight inches; its legs terminating in one sharp hook or nail of a shining black colour; all of which are said to be venomous. But its most formidable weapons, are two sharpened or hooked instruments, that are placed under the mouth; at the extremity of each of which, there is a small opening, from which extends a tube for the poisonous fluid to be conveyed into the wound inflicted by its fangs. It has eight very small eyes, four on each side of the head near the antennæ; and the number of the segments of the body and the legs increase with its age. Its poison, (though very active, and productive of extremely distressing symptoms,) is not so injurious as that of the scorpion; and is only fatal to the smaller class of animals. A fly is instantaneously killed by its bite; and in dogs and in brute animals of the larger description, its wounds leave a rancorous sore of many weeks continuance. St. Pierre, in his Voyage to the Isle of France, observed this animal overcome by a flight of ants, which attacked it in conjunction; and after seizing it by all its legs, triumphantly bore the body along, as workmen would have done a large piece of timber.

With the hornet, the bee, and the wasp, and the stings which they inflict, you must be too familiar, to render it necessary for me to enter into their natural history. I shall therefore briefly observe, that the sting of these insects is composed of three parts—the sheath and two darts, which are extremely small and penetrating. Each of these darts has two small points, or barbs like fish hooks; which render the sting more painful, and cause the dart to rankle in the wound. The sheath, which has a sharp point, makes the first impression, which is followed by that of the darts; and from these, the venomous liquor is ejected into the wound, to which the sheath sometimes sticks so fast, that the animal is obliged to leave it behind; adding much to the inflammation of the part; though such wounds are seldom attended with any serious consequences.

There are a few other smaller insects, particularly among the fly, gnat, and ant tribes, that may be considered venomous; and whose bites or sting, cause great irritation and inconvenience to the human subject, more especially in warm climates. Among these, the tropical gnat, or mosquito, and the fire ant of South America, take the lead. The mosquito prevails in overwhelming proportions upon the sea coast, and in the vicinity of lagoons, low woods, and swamps in all countries within a few degrees of the equator; and prove an unfailing source of discomfiture, pain, and disfigurement to such Europeans, more especially if strangers, who happen to reside within their reach; rendering too often unavailing the active measures usually adopted to guard against their bites.

The fire ant is to be met with in Africa, but in the largest proportions in South America. This insect has been particularly noticed by Captain Stedman, in his Travels in Surinam. He says, "these insects are black and very diminutive; but live in such amazing multitudes together, that their hillocks have sometimes obstructed our passage by their size; over which if one chances to pass, the feet and legs are instantly covered with swarms of these creatures, which seize the skin with such violence in their pincers, that they will sooner suffer their head to be parted from their body, than let go their hold." The burning pain, which they occasion, cannot, in his opinion, proceed from the sharpness of their pincers only; but must be owing to some venomous fluid which they infuse, or which the wound imbibes from them. "I can aver," says he, "that I have seen them make a whole company hop about, as if they had been scalded by boiling water."

The treatment of the wounds inflicted by all the insect tribe which are venomous, requires very little variation from that recommended for the bite of the viper. Simple olive oil carefully rubbed into the part affected, olive oil to which a third part of liquid volatile alkali has been added, equal parts of laudanum and volatile alkali, and the volatile spirit of amber or eau du luce, have each in their turn produced the best effect; or where more than ordinary symptoms have occurred, the carbonate of ammonia and oil of amber administered internally, as recommended in the bite of the viper, have seldom failed to afford relief.

We come now to a description of a disease, the most fatal and the most formidable of any to which human nature is liable—we allude to *Hydrophobia*, as produced by the bite of a rabid animal, most frequently the dog. It fortunately however happens, that though we do not unfrequently hear of dogs and of other animals becoming rabid, or of individuals being bitten by such animals, yet hydrophobia in the human species is a very rare disease; insomuch that many physicians, of very high reputation and of most extensive practice, have closed a long life without once witnessing its symptoms; among whom may be mentioned the celebrated Dr. Cullen of Edinburgh, Dr. William Heberden senior, of London, and others whose names do not immediately recur to us. But as the disease is always liable to happen after the bite of a rabid animal, it is highly important that we be acquainted with its character, and with the means we possess of guarding against its consequences.

Hydrophobia, which is derived from two Greek words, that combined, signify a dread of water, is a term that does not convey a clear idea of the disease on which we now propose to treat. Since it merely refers to one single symptom, in which the patient has no aversion to water, but on the contrary, from his extreme thirst, he has a most anxious wish to indulge in its use; but in consequence of the muscles concerned in deglutition, being painfully affected, which renders swallowing a matter of great difficulty, and of fluid articles when swallowed, occasioning a greater action in those muscles, then such as are solid; the dread of the patient arises from the association naturally produced, when water, or any other fluid, is brought within his observation; and this instinctively leads to an anxiety, amounting to a command, to have such articles immediately removed from his sight, though most frequently at a time when he feels the greatest desire to allay his thirst by their use. As the designation, however, is familiarly understood to imply that disease which more usually is produced by the bite of a rabid animal, and as we have no better appellation to propose, we must shelter ourselves under the privilege of custom in continuing a term, which, in a scientific point of view, our judgment condemns as incorrect.

There is no disease to which the human frame is subject, in which the early and subsequent symptoms have been so various, or the time of approach so uncertain, as that of hydrophobia. This renders an accurate description of some difficulty, and leaves us no other choice but that of a general delineation of a disease which is only to be known by actual observation. The following, however, may serve to point out perhaps its leading features, so as to admit of its being recognized, should you fall in with a malady of so formidable and so fatal an aspect.

At an uncertain period after the bite has been inflicted, sometimes in a few days, more frequently in about five or six weeks, seldom exceeding as many months, and still more unusual at so great a distance as a twelvemonth, the person feels a renewed uneasiness and pricking pain in the vicinity of the part where the wound had been inflicted; which not unfrequently is followed by swelling and inflammation immediately round the citatrix or scab, if the wound had been previously healed, which in most instances is the case; the cicatrix becoming elevated, hard, and extremely painful. This pain extends to all the surrounding muscles; and, following the course of the absorbents, it advances towards the trunk. If the wound has not healed, it increases in size and inflammation upon the approach of the hydrophobial symptoms, and becomes a painful and rancorous ulcer. Upon other occasions, all the symptoms have been ushered in without any local irritation, the cicatrix remaining unaltered to the last, and in some instances has been entirely obliterated.

A general indisposition, loss of appetite, languor, a timid anxiety about the nature of the malady which is often attributed to the wrong cause, disturbed sleep, frightful dreams, frequent sighing, an uneasy sensation about the præcordia, and other symptoms similar to the first attack of low nervous fever, mark the commencement of this most lamentable malady; and which, on some occasions, have continued several days before the real disease has been identified. At other times, the unequivocal symptoms of hydrophobia have come on at once, without any previous indisposition; and in that case, they have been ascertained by the early occurrence of the following symptoms; namely, a spasmodic affection of the muscles generally, and of the throat in particular—a great horror at the sight of water, or of any other fluid, or indeed of any article which is likely to associate with it the idea of swallowing—considerable agitation upon the air of the room being put in motion, or upon the least movement and increased noise in the chamber—a strong aversion to light—bilious vomiting—great thirst and desire to drink, but immediately convulsed upon the least attempt to swallow—feverish heat of the skin with a furred tongue—and a quick, small, and weak pulse. With these symptoms, the patient is perfectly sensible, and is conformable to instructions, even naming the articles of drink and diet he wishes to have, though the attempt to swallow, throws the whole frame into the most agonizing convulsions; while the mental anxiety about the consequences advances with the progress of the disease, and is a leading feature as long as consciousness remains. In a few hours, all these symptoms become increased. More or less of delirium has commenced with occasional raving, and sometimes screaming; and which, combined with the aridity of the throat, and hoarseness of the voice, convey, with a little help of the imagination, the idea of barking. Yet with all these untoward symptoms, the patient seldom entirely loses his reason, or a consciousness of his situation; and has generally a confused recollection of the persons about him. In this stage of the disease, his tongue is dry, rough, and swelled, and frequently is seen hanging out of the mouth—his throat is arid, hoarse, and sonorous—his eyes red, fierce, and protuding—an immense excretion of viscid saliva passes out of the mouth, which the patient in the last stage sometimes endeavours to eject upon his attendants, and sometimes he attempts to bite those immediately within his reach, thence requiring personal constraint upon his actions—frequent convulsions, which frightfully distort the features, and give a most appaling aspect to the countenance, now very soon supervene; and in this state, between delirium and returning reason, the afflicted object is released from his sufferings by an overwhelming fit, or by an exhaustion of the vital powers; the disease, when completely formed, frequently terminating its fatal course within the short period of forty-eight hours.

This is only to be considered as one form of a disease, which, as previously intimated, is seldom seen in two individuals exactly alike. Its distinguishing features, however, are pretty uniformly present in all instances; namely—in the early stage, great depression of spirits and an alarm about the consequences, anxiety and pain about the præcordia, spasmodic affection of the muscles; and as the disease advances, convulsions at the sight of fluids, and great dread of swallowing any kind of substance, considerable excretion of viscid saliva from the mouth, incipient delirium, and such a marked peculiarity of countenance, as cannot well be mistaken.

The appearance on dissection of the human subject, as well as of brute animals which have died of this disease, are as various in different individuals as the symptoms; sometimes presenting an inflammation of the trachea or windpipe, commencing at the epiglottis, with a determination of blood to the lungs—sometimes an inflammation of the tongue and fauces, extending through the gullet, to the internal coat of the stomach and small intestines—occasionally an inflammation of the membranes of the brain, with some effusion into its cavities; and in many instances, no organ has appeared affected that could at all account for the disease.

I was present at the examination of two persons who had died of hydrophobia; one at the London Hospital, the other at the anatomical theatre, Great Windmill Street; in neither of which did we trace any appearances that could explain the phenomena of the disease; and as this has happened in some other instances, it would lead us to hope, that hereafter some remedy may be discovered which, applied vigorously at the first approach of the symptoms, may arrest their progress, and thus preserve the life of the patient.

The cause of this most lamentable of all diseases, in most instances, is the introduction of the saliva of a rabid animal, most frequently the dog, into a wound inflicted by its bite; which, being absorbed and conveyed into the blood vessels, produces the train of symptoms we have described. It has occasionally happened however, that a similar disease to hydrophobia has occurred in the human subject, where no bite could be traced to any animal whatever. In that case, it has been denominated *spontaneous hydrophobia;* and when we add to these facts the circumstance, of only one, out of about thirty, being seized with the disease who have been bitten by dogs supposed to be rabid; it exemplifies in a striking degree our ignorance of its causes, and what a wide field is still open for discovery upon a subject, in which the interests of humanity are so deeply concerned. Again, we are as unacquainted with the cause of the dog species being so peculiarly liable to this disease, as we are with the manner in which it produces its effects, on the human constitution; or whether, in the dog, it is spontaneously produced, or is communicated by contagion only, or whether it depends upon particular habits, modes of diet, or certain privations, or upon an especial constitution of the atmosphere. All that we know is, that it appears more frequently in some seasons than in others; that it is not confined to hot or cold weather, though the extremes of temperature are more favourable to its production; that it is equally observable in the East Indies and America as in Europe; though Syria, Egypt, the states of Barbary, the Cape of Good Hope, and the West Indian Islands, from causes which we cannot explain, have hitherto, with very few exceptions, escaped its invasion; and that in whatever country it has appeared, the prospect of cure has been equally hopeless.

Remedies, from time immemorial, have been handed down to us as certain specifics for the prevention of hydrophobia; and which, from the few instances of that disease following the bite of a dog supposed to be rabid, and from the difficulty often in ascertaining whether the dog really were rabid or not, have for a considerable time preserved a reputation, which subsequent experience has proved, they have not merited.

Among these may be first mentioned, the *Ormskirk powder*, the leading ingredient of which is *chalk*, introduced under the supposition of the poison being an acid, which such an absorbent is calculated to neutralize. This remedy, which repeated trials have proved to be perfectly inefficacious, has had a long run, and is hardly out of use at the present day.

The next is the *Tonquin powder*, an Asiatic remedy, composed of red sulphuret of mercury and musk, two very powerful ingredients, which are stated to be efficacious in the climate in which they are administered, but of the infallible effects of which, we have had no certain confirmation.

The third is the *Carnatic or Tanjore pill*, an East India preparation, in which arsenic, mercury, and some Asiatic vegetables with which we are not acquainted, take the lead.

The fourth. Sea bathing, amounting almost to drowning.

The fifth. Mercurial frictions, so as to produce an active ptyalism to be long continued.

The sixth. Scarifications of the parts followed by the actual cautery, or by strong caustic applications well rubbed in; or the destruction of the part by caustics, and then keeping up the irritation by strong mineral solutions.

The seventh. Extirpation of the part, and keeping up a discharge by active applications.

The eighth and last. Tying a ligature above the wounded part to retard the return of the blood to the heart, and then to destroy the part by caustics.

In the treatment of the disease itself, when it actually takes place, we are still at a greater loss how to proceed; and its symptoms too often advance with wonderful rapidity, unchecked by our feeble efforts, and setting all medical skill and ingenuity at complete defiance. Cases however are upon record, in which recovery has followed the attack; but these are so few, and the treatment of each so contradictory, that we hardly know how to place confidence in the means adopted.

As it may be useful to know the marks by which a rabid dog may be distinguished, we shall conclude our observations on hydrophobia, by introducing an extract from the work of Dr. Orfila, a French author, who, as we have already noticed, has published a valuable treatise on poisons.

"According to Messrs. Enaux and Chaussier, the disease begins by the dog being languid, and more dull than ordinary. He seeks for obscurity, remains in a corner, and ceases to bark; but growls excessively at strangers, and that without any apparent cause. He refuses food and drink. His walk becomes vascillating, like that of a person almost asleep. After two or three days, or in the second stage, he walks like a drunkard, and frequently falls. His hair stands erect; his eyes fixed and haggard--his head hangs down--his mouth is wide open, and contains much frothy saliva—the tongue is protruded, and tail turned inwards. He avoids water, which appears to redouble his distress. He suffers from time to time an increase of fury, and endeavours to bite every object, not excepting his master. The light and vivid colours augment his distress. At the end of thirty or thirty-six hours, after the latter appearances, or from the commencement of the second stage, he dies in convulsions. The dead body putrifies in the most rapid manner, and diffuses a most infectious odour. It ought not to be left exposed above ground, lest it should be eaten by other animals, which might in consequence become mad also. The hole into which the body is put, should be very deep, and every part of the place should be well washed with lime water; and all the vessels, from which he took his food, should be destroyed. The person, who touches his body, should be well washed with vinegar."

Since our work has been sent to the press, we have had an opportunity of perusing the very excellent treatise on Canine Pathology of our friend, Mr. Blaine, and of conversing with him frequently on rabies. By that gentleman we have been informed, that in all the instances of the disease which have come under his observation, (and these have been upon the most comprehensive scale,) he has uniformly traced the cause of the malady to the contagious bite of another rabid animal, and not to a spontaneous origin. That consequently its appearance has not depended upon season, the abstraction of water, improper diet, confinement, or any other of the usually attributed causes; but that particular states of the weather, and other sources of constitutional excitement, seemed considerably to hasten its attack. And that its occurrence has never failed to be prevented, whether in the human subject or in the brute animal, provided the wounded part be judiciously excised, or cauterized (the cautery Mr. Blaine seems to prefer,) at any period prior to the second inflammation of the wound.

Mr. Blaine has further communicated to us, that the drinking of water, and the absence of a mischievous disposition on the part of the suspected animal, are most erroneous and dangerous tests of security; since he has repeatedly seen both the one and the other occur, in animals which have been labouring under the most active forms of the disease.

But that you may be in possession of the whole of the facts upon this very interesting subject, which Mr. Blaine in his publication has so ably and scientifically detailed; I cannot conclude my lecture better, than by recommending to your perusal a work, which is universally admitted to contain the best (as it certainly is the most accredited) account of canine pathology, of any we at present possess.

LECTURE IV.

ON ANIMAL AND VEGETABLE POISONS.

(Concluded.)

Having submitted to you at our last meeting, such observations as I had to offer upon those poisons which produce their effects by being introduced into the blood vessels from the bites or stings of venomous animals, we are next led to treat upon those substances which act upon the system through the medium of the stomach; of which I have selected poisonous fish and vegetable poisons, for this day's consideration. But as previously it may be useful to possess some general knowledge of the organs upon which the deleterious articles, about to be described, produce their first effect, I shall, in terms, as concise and as familiar as the nature of the subject will admit, endeavour to explain to you their structure and uses.

It will be necessary to premise, that there is one grand intestinal canal, through the agency of which, the food is conveyed, digested, and converted into chyle or nutriment for the supply of the waste constantly taking place in the animal body. The first part of this tube has been denominated *the pharynx;* which commences from the back of the mouth, and passing behind the larynx or commencement of the wind-pipe, soon terminates in the second part, or continuation of the tube called the *æsophagus* or *gullet:* which preserves that name until it reaches the upper portion of the abdomen, and then forms the *stomach;* immediately below which, the *intestines* (being still an elongation of the same canal,) commence, filling up the middle and lower portions of the abdomen.

The pharynx and æsophagus perform no other part, but that of receiving the food which has already undergone a partial preparation in the mouth by mastication and admixture with the saliva, and of propelling it into the stomach, where it is retained, until it has been digested; that is, until it has been intermixed with a secretion from that organ termed the gastric juice, and so churned (if we may use the expression) by the action of the stomach, the diaphragm or midriff, and of the abdominal muscles, as to be reduced to a fine, soft, homogeneous pulp, termed the *chyme*; in which state it excites the muscles of the stomach to force it into the upper part of the intestines, where it meets with the bile from the gall bladder and liver, and with a secreted fluid from the *pancreas.* By the chemical operation of these two fluids, the *chyle*, or nutritive part, is separated from that which is feculent and superfluous; and being absorbed and conveyed into the blood, serves to supply the waste which the secretions, and other operations in the animal economy, are uniformly occasioning.

This tube, which throughout is supplied with blood vessels, nerves, glands, and absorbents, has three coats—the outer of which is *membranous*, serving as an external covering; the second, or middle coat is *muscular*, by which the actions of the tube are produced; and the third or internal is *villous*, that is fibrous and velvet like, in which is the apparatus that separates the fluid (more especially in the stomach,) so essential to the process of digestion.

The stomach, though forming part of the same tube, differs from the other portions of it, in its shape, situation, and capacity; in the number and arrangement of its muscular fibres; in possessing a much larger and a far more active expansion of nervous membrane by which it sympathizes directly with many other important organs; in an apparatus for the preparation of the gastric juice, the grand menstruum of digestion, and, by laying horizontally, in being the receptacle and the chief source of action of every thing that passes from the mouth into the tube. We cannot, therefore, be surprised, that any great injury done to this organ, should so frequently be productive of dangerous and the most serious consequences to the animal frame in general; though, as upon a former occasion, we have observed, very extraordinary liberties are frequently taken with it, the operation of which it possesses, in many instances, a wonderful power of resisting, and of still preserving its healthy functions to a very late period of life.

We have deemed it necessary to trouble you with this short account of the grand intestinal canal, because when poison has been received into the stomach, there is no part of the tube, which does not organically or sympathetically partake of the injury; and you will the more readily understand how in such instances the more distant organs become affected, and what are the morbid appearances likely to be presented upon dissection, when cases of poisoning become the subject of judicial investigation.

Should we have been so fortunate as to have made ourselves clearly understood in this very brief account of the structure and functions of the digestive organs, we may with advantage commence our observations upon those poisons which produce their effect on the animal system by being previously received into the stomach.

These substances, which are derived from the animal, the vegetable and the mineral kingdoms, act very variously upon different individuals, and upon different animals; indeed so much so, that in some animals, the smallest proportions are productive of the most baneful consequences, while in others, they are taken with impunity; and many of the vegetable tribes in particular, which, in their natural state, are the most active poisons, by culinary and other processes, are rendered a luxurious, and nutritive diet. This circumstance serves to confirm an observation made in a former paper, that none of the substances denominated poisons, are without their use in the arts, in medicine, or in domestic economy.

In the animal kingdom, many of the fish tribe, which have a direct poisonous effect upon some individuals, may be taken by others with impunity; and many substances are eaten by quadrupeds and birds, which are uniformly poisonous to man; while particular articles which are favourable to the human constitution, prove immediately destructive to the brute species.

Aloes, which, to man, is an useful drug, has been found to kill dogs and foxes; and the sweet almond, one of the luxuries of our table, is poison to cats. The phellandrium aquaticum, or water fennel, while it is fatal to horses, is eaten greedily by oxen. The bird pepper, from which cayenne is prepared, and which is only used in the smallest proportions as a condiment by the human subject, forms the principal article of food to the wild parrot, which picks out the seeds that are the strongest in preference to every other; as I have often witnessed in the West Indies. The land crab of St. Domingo feeds on the leaves of the manchineel tree, which, to every other animal, is an active poison; and many other illustrations might be offered in confirmation of the variable operation of the vegetable poisons upon different animals.

The articles, therefore, which *uniformly* are destructive of animal life, are very limited indeed; though the human subject appears to be susceptible of the operation of an extensive range of substances, from which most of the brute species are more or less exempt.

Having submitted these general observations on the comparative effect of poison upon the animal frame, when received into the stomach, we shall be the better prepared to treat upon particular poisons, commencing with *animal substances;* of which the *Lytta Vesicatoria,* cantharis, or, in more familiar language, the spanish fly, shall be the first for consideration.

This animal is a native of the southern parts of Europe, including Spain, Italy, France, and southern Germany. The largest proportion is brought from Italy; but those of the best quality are to be found in Spain.

These flies are proportionally long, and externally present to the eye a beautiful covering of mixed green and shining gold, which in a Mediterranean sun has a splendid effect, not a little increased by the expansion of their membranous wings when in the act of flying; and which, from being of a dark brown, form a striking contrast with the brilliant colours of the other parts of the body. When they alight, they usually fix themselves upon the alder, the willow, the ash, or upon trees of that description; the branches of which being shook, they drop into a cloth placed underneath for the purpose, and are killed with the fumes of sulphur, or of some other poisonous substance, and dried in a stove for use.

The cantharides pulverized, it is well known, form the principal ingredient in blisters; and, in the hands of skilful physicians, perhaps there are few articles in the materia medica of such important and comprehensive use, or where so many diseases are relieved by their application.

Internally, the spanish fly is more usually given in the form of tincture; and, under *a very guarded management*, is capable of relieving some important diseases. To the smell, this fly is particularly offensive; and to the taste, it is acrid and burning. When taken internally, (unless administered in the most diminutive proportions,) it produces fatal inflammation of the stomach, bladder, and of other important viscera, accompanied with excruciating pain, and a train of distressing symptoms, exceeded perhaps by few even of the most active poisons. Similar symptoms, in a more modified degree, are sometimes occasioned by the absorption of the fly after the application of blisters; the management of which, in particular constitutions, requires much discrimination and judgment.

Cantharides, in an over dose, may be taken by mistake, and thus produce the symptoms we have enumerated. Or it may be given for the felonious purpose of poisoning, as in the case of Sir Thomas Overbury, to whom it was administered in his sauces; or it may be taken in some other form, with the same diabolical intention. Dr. Male informs us, that a mixture of opium and cantharides is reported to be one of the Neapolitan slow poisons, the surest and most infallible.

To remove the symptoms produced by an over dose of cantharides, or by their absorption when externally applied, the most suitable remedies are, copious dilution with mucilaginous drinks as linseed tea, a solution of gum arabic in barley water to which a proportion of the nitric ether has been added, milk and the like; oily and demulcent medicines, with or without opium as circumstances shall require; fomentatio s; the warm bath; and, if requisite, the free application of leeches.

The other animal substances, which, when received into the stomach, discover a poisonous tendency, are certain fish both of the scaly and shell kind, several of which prove *uniformly* deleterious to the human constitution, and which, if not attended to, will frequently occasion death; while others have the same effect upon particular individuals only, or at certain periods, producing a similar train of symptoms, differing in degree according to the circumstances of the case.

The first, or scaly poisonous fish, are more peculiar to warm climates, though accidentally they are to be met with in the northerly latitudes: the eating of them is always attended with the greatest danger, not unfrequently producing death in half an hour after they have been taken.

The most poisonous of this class are the *barracuda*, the *king's fish*, the *cavallee*, the *rock fish*, and the most dangerous of all, the *yellow bill sprat*. They are each to be found in the West Indian seas; and those fish which are the largest, and have the fewest scales, the tropical fishermen consider to be the most suspicious. The following account of the symptoms produced by the tropical poison fish has been taken from the work of Dr. Thomas, who himself suffered from eating the rock fish.

" Certain and rapid death is almost sure to ensue from eating the yellow bill sprat. From the use of this, and of most other species of poison fish, the person is seized after a few hours with languor, heaviness, and faintness, succeeded by great restlessness, flushes in the face, giddiness, cardialga, nausea, pains in the intestines, and severe cholera. The burning, which was only first felt in the face, is extended over the whole body, but more frequently to the palms of the hands and soles of the feet; and is often succeeded by an eruption, or efflorescence rising up in large bumps similar to bug bites, or the nettle rash. The pulse is usually hard and frequent at first, but soon becomes low and feeble. With the ardor of the skin, there is invariably a pricking sensation in the hands when immersed in cold water, which leading symptom will always enable us to decide with confidence on the disease. In the advanced stage of the disease, I observed that the whole surface of the body acquired a deep yellow hue as in the jaundice, and that even the perspiration gave a deep yellow stain to the linen. This happened particularly in my own case, as I was so unfortunate once to experience the deleterious effects of a poisonous rock fish. When a large quantity of the fish has been taken, or the fish has been of so deadly a nature as to prove fatal, the patient generally goes off in strong convulsions; but when the quantity and nature of the fish have not been so powerful as to occasion death, and the violence of the disorder suffers some abatement, the body becomes emaciated, the cuticle peels off in various parts, but more particularly in the palms of the hands and soles of the feet, the hair drops, and acute shooting pains in the articulations of the wrists, knees, and ankles are felt for a considerable length of time. From the great debility induced, it not unfrequently happens, that œdomatous swellings of the lower extremities ensue. The poison of fish is always attended with much immediate danger, and even when the person escapes its deadly consequences, his constitution most frequently receives such a severe shock, as to render it necessary to visit a cold climate."

This account of Dr. Thomas of a very distressing train of symptoms produced by the swallowing of poisonous fish, I believe to be perfectly correct, as during my residence in the West Indies, I had frequent opportunities of seeing the poisonous fish which he has described, and of obtaining information on their very deleterious effects when received into the stomach.

The second order of fish, which only produces *occasionally* dangerous symptoms, are the *congor eel*, the *dolphin*, the *muscle*, the *eel*, the *salmon*, and (in particular constitutions) all the varieties of the shell fish. Of these, the muscle, may be considered by far the most frequently injurious; and there are few persons who have not witnessed in themselves, or in their friends, the bad effects produced by eating this fish.

Two interesting cases are reported in the Medical Repository, for June, 1815, by Dr. Burrows, one of the editors; where the eating of muscles taken from the foul bottom of a fishing smack in the canal at Chatham, had proved fatal in sixty-seven hours. One of these was a boy fourteen years of age, and the other was a boy of nine years. The leading symptoms in these cases, "were nausea, head ache, vomiting of a dark green fluid, an eruption like the nettle rash on the skin attended with intolerable itching; great difficulty of breathing; excessive pain in the abdomen and bowels; intense thirst; swelling of the abdomen and face; a numbness and coldness of the extremities; delirium; coma or stupor; dilated pupils of the eyes; a sunk, low, and tremulous pulse, subsultus or catching of the tendons, convulsions, and death. The bodies soon after death became livid and putrified; but as their unhappy mother objected to their being opened, the appearances on dissection could not be ascertained."

Captain Vancouver relates that several of his men were ill from eating muscles, which they collected, while exploring the coast of America in the North Pacific Ocean. Three of them suffered more than the others; and one of them died in less than five hours after the fish had been swallowed, very tranquil and apparently in a deep sleep. His lips had turned very black, and his extremities were much swollen. The other two men, by drinking plentifully of warm water and exciting vomiting, escaped with their lives; but were ill for many days afterwards.

Upon my arrival at Gibraltar, in the year 1788, five years after the last memorable siege, I was informed that some persons had very lately been poisoned, and others much injured, by the eating of muscles; and that upon inquiry, it was ascertained, that the fish, which had produced these mischievous effects, had attached themselves to the copper bottoms and broken portions of the Spanish gun boats and floating batteries, which had been sunk in the bay, when the last unavailing effort had been made by the enemy to get possession of the garrison. Muscles were, in consequence, considered a poisonous fish, and fell into complete disuse; and oysters, which there, are of a very fine quality, were eaten for some time with great caution.

Much ambiguity attaches to the sources from which these, and some other fish, derive their poisonous qualities; as well as in what part of the fish, the poison is the most active. It appears to be a good precaution, however, (and which is confirmed by the testimony of Dr. Thomas, who states, that the entrails of the tropical poison fish, if well removed, destroys its deleterious quality, or if given to a dog, cat, or duck, immediately poisons them;) to gut all fish well, and to wash the inside very clean before it be used; and in the muscle to remove every dark and black portion from it, previously to its being eaten; and to find out if possible, upon what bank, or shore, it has been taken.

In the West Indies, the mountain crab is considered one of the greatest luxuries which those islands produce, and it forms a leading article at every gentleman's table. In Jamaica, they have only one species, which is the black crab; the flesh of which is extremely light and easy of digestion. In St. Domingo, twenty leagues only to the eastward of Jamaica, there are two species of mountain crabs; the one black as in Jamaica, and the other white; terms which are derived from the colour of their shell and flesh. The black crab of St. Domingo, like that of Jamaica, is a very wholesome diet. The white crab, which in the latter island is to be found in profusion, from feeding on the leaves of the manchioneel (a highly poisonous tree peculiar to the West Indies,) possesses a very deleterious quality when received into the stomach, and therefore is most carefully avoided. From all these circumstances we are led to conclude, that shell fish of every kind, in consequence of their occasionally feeding upon, or being attached to poisonous substances, may in particular instances disagree with the stomach upon one occasion, while upon another, it proves easier of digestion than any other article of food.

It may here also be mentioned that there are certain idiosyncrasies, or peculiarities of constitution belonging to individuals, by which particular articles shall uniformly disagree, and sometimes produce very alarming effects, while every other article not immediately poisonous, may be taken with impunity. This observation is particularly applicable to the eating of fish, and to those of the shell tribe, more than any other; the effects which they produce, when they disagree, bearing a strong similarity to those occasioned by fish that are uniformly poisonous, differing only in degree.

The symptoms of the poisonous effects of shell fish are, languor, depression of spirits, nausea, heartburn, vertigo, a sense of weight with great pain in the region of the stomach, active cholera, burning heat on the skin extending from the body to the extremities, particularly in the palms of the hands and soles of the feet, and most frequently, an effloresence or eruption on the skin, attended with intolerable itching.

These symptoms, if not relieved, sometimes terminate fatally, like those we have detailed as produced by the eating of the scaly poisonous fish, and therefore they cannot be too promptly removed.

In the treatment in both instances, the first object is to get rid of the offending matter as quickly as possible. Nature, fortunately, very often effects this purpose without the aid of art, by bringing on very active cholera; in which she is to be imitated, by remedies that will very quickly clear the primæ viæ. The next indication, is to arm the stomach against the operation of such portions of the fish as may not have been ejected by such remedies; and, if possible to decompose them. For this purpose, the carbonate of ammonia, combined with ether and opium, will be found a very efficacious medicine, particularly if assisted by fomentations and the warm bath, so as to promote a determination to the skin. In the West Indies, the capsicum, or cayenne pepper, freely administered, is considered an antidote against fish poisons; and in that climate, where the inflammatory disposition does not prevail, this may probably answer better than any other, remedy; its use in this country, must be regulated by the constitution of the patient. Should increased pain, swelling, and tention of the abdomen supervene, free local depletion by cupping glasses, or by leeches, should be resorted to, to be succeeded by fomentations and a blister; saline medicines, with plentiful dilution, are in that case to take the place of the volatile cordial remedies; and should cholera prevail, opium is to be administered as circumstances shall indicate.

To ascertain the poisonous quality of fish, it has been a custom in the West Indies, to give the entrails to a dog, cat, or duck; and if no bad effects ensue, to conclude the fish to be wholesome. Another method, is to put a silver spoon into the water in which fish is boiling; and if, upon taking it out, the spoon be unsullied, the fish is supposed to be safe; but if the colour be at all changed, then it is considered dangerous. But these experiments, for obvious reasons, are not to be too hastily depended upon.

Having finished our remarks upon the first and second classes of animal poisons, and proposing to reserve our observations upon the third class, viz. the different contagions, for a more suitable opportunity; we shall now proceed to the consideration of those poisons which are derived from the vegetable kingdom.

Vegetable poisons have been divided into *acrid*, and *narcotic*, according to the effects which they produce, upon being received into the stomach; the first, or acrid, causing pain, inflammation, and erosion of the parts to which they are immediately applied, and acting more remotely upon the distant organs; the latter, or narcotic, acting principally upon the brain and nervous system, and less dangerously on the stomach and other parts of the grand intestinal canal, to which they have been first applied. This distinction, however, is not to be made without some reserve; since all the vegetable poisons produce a combined effect upon the digestive organs, and upon the brain and nervous system; it being only in a relative degree, that the difference is to be observed.

It would be an endless attempt, and not very amusing, to give you a detailed account of all the vegetable poisons, which have been termed acrid;

as more than seventy articles have been set down by the writers on the materia medica as belonging to that head. It will be sufficient to point out a few which perhaps may be more familiar, and which are the most likely to be misapplied in their use.

Among these may be enumerated, aconitum, monk's head, or blue wolfsbane, which is also a strong narcotic; the colchicum, or meadow saffron; the colocynthis, or bitter apple; the elaterium, or wild cucumber; euphorbium, which is prepared from a species of spurge; hellebore; gamboge; sedum acre, or houseleek; the sabina juniperis, or savine; the scilla, squill, or sea onion; scammony; and, the stavisagrea, or stavisagre.

All the above articles begin to shew their effects immediately upon being received into the mouth, where they produce an acrid taste, heat, smarting, dryness of the fauces, and a constriction of the throat. Upon descending, they occasion nausea and vomiting; and when they have reached both the stomach and intestines, severe pain and spasm in those organs, active and most violent cholera, swelling and tension of the abdomen, a strong and frequent pulse, a hurried and difficult respiration, considerable vertigo and pain and weight in the head, muscular spasms, (particularly of the throat and face,) and general distress and anxiety. These symptoms are succeeded by cold perspirations, much nervous depression, a very dilated pupil of the eye, a slow feeble pulse, convulsions, and death.

Most of the articles previously alluded to, though in an over dose, strong poisons, are used in medicine; and in the hands of prudent and skilful physicians, many of them prove remedies of great value. But as they all possess very active qualities, too much discretion cannot be observed in the application of them to medicinal purposes.

The appearances, on dissection of persons who have been destroyed by any of the acrid vegetables, are much the same as those produced by the mineral poisons, differing only in degree. Great swelling and livid appearance of the abdomen; inflammation, erosion, and gangrene of the stomach, intestines, and sometimes of the æsophagus; and occasionally, a determination of blood to the head; are the circumstances most observable in such cases.

In the treatment, the principal object is to clear the prima viæ of the offending matter with as little delay as possible; to sheath the whole of the grand intestinal tube from the acrimony of the poison by demulcent remedies; to remove fever and inflammation when present; and to support the constitution with cordials when symptoms of exhaustion supervene. For this purpose, a quick operating emetic, mild aperients, demulcent drinks, general and local bleeding, fomentations and blisters, saline diaphoretic medicines, the warm bath, and lastly, cordial medicines, with wine, opium, and a more generous diet are to succeed each other in the order in which the symptoms present themselves, and to be applied in the way that circumstances shall suggest, or omitted, if there be no indication for their use.

We come next to the consideration of those vegetable substances which, from their more evident effect on the brain and nervous system, have been termed *narcotic*, from narcosis to stupify, and which taken in overdoses prove very active poisons; and as accidents from these substances are of much more frequent occurrence than from those which have been termed the acrid poisons, we shall enter more particularly into their history, than we deemed necessary when treating on the latter description of vegetables.

We have had occasion to notice in an early part of this paper, that a large nervous expansion is peculiar to the structure of the stomach, by which it sympathizes with the brain and nervous system in a very remarkable degree. We are, therefore, not to be surprised that those substances, which, by experience, we have ascertained to possess narcotic qualities, should, when received into the stomach, produce a train of symptoms which are immediately referable to the brain. For though the stomach be uniformly and primarily affected in such instances, yet its internal coat is not inflamed and abraded in the same degree as when the acrid poison have been administered; while spasmodic affections of the muscles, delirium, stupor, apoplexy, palsy, and fatal convulsions, are the never failing consequences of an excessive dose of the narcotic vegetables, and which symptoms are immediately referable to the brain and nervous system.

The vegetable substances, which belong to the above class, as they are to be found in this country, are principally—the atropa belladona, or deadly nightshade; the cicuta, or hemlock; the hyoscyamus, or henbane; the datura stramonium, or thorn apple; the lauro cerasus, or common laurel; the digitalis purpurea, or fox glove; the aconitum, or wolfsbane; and the inspissated juice of the papaver somniferum, or opium.

The *Atropa Belladona, Solanum Lethale*, or *Deadly Nightshade*, which, from the berries having an inviting appearance resembling black grapes is sometimes eaten by children, is a very active poison. It grows in many parts in this country in shady situations, presenting its ripe fruit in September. Its root sends up annually several erect stems of a purple colour, from two to three feet in height, branching out with lateral leaves in pairs, of a dusky green above, and of a pale hue below. Its flowers, which bloom in June, are bell-shaped; producing berries, which, as they are the most frequent cause of accidents, we beg particularly to state are to be distinguished when ripe, by their situation within the calyx or cup, by their round form with a longitudinal furrow on each side, by their deep purple colour with a shining smooth skin, by their containing several kidney-shaped seeds, and more especially, as differing from the black grape, by the fruit being double in the place of single.

The effects of the belladona as a poison, are giddiness, difficult respiration, pain or tightness at the chest, distressing thirst, dreadful ravings, fatuity but no stupor, the jaws are frequently closed as in tetanus, the eyes staring, the pupils dilated and insensible to light, with universal agitation and trembling (particularly the tongue,) difficulty in swallowing, unavailing efforts to vomit, convulsions, and death. The body soon putrifies, swells remarkably, and is covered with livid spots. Blood flows from the mouth, nose, and eyes, and the stench is unsufferable.

There is another species of this plant to be found in our hedges, named the *Woody Nightshade*, which, from bearing beautiful red berries resembling currants, also frequently attracts the attention of children, who are sometimes induced to eat the berries; which, as well as the plant, are poisonous, though not in the same active degree as in the former plant. A guarded use of the belladona however, it appears, has been tried on the continent with good effect in convulsive complaints, palsy, mania, and in cancer; though it requires very judicious management in its application.

The *Conium Maculatum*, *Cicuta Major*, or *Greater Hemlock*, is another of the vegetable poisons which not unfrequently has led to accidents from the mistaking it for some other vegetable; and which also has been usefully applied in medicine for diseases of a similar kind to those in which the belladona has been prescribed.

The cicuta grows naturally on the banks and sides of roads in this country, and has a large taper root like a small parsnip. The stalk is smooth, cylindrical, spotted with purple, and covered at its inferior parts with black spots. It rises from three to upwards of five feet high, branching out towards the top into several smaller stalks, garnished with decomposed leaves, whose lobes are cut at the top into three parts. These are of a lucid green, and have a disagreeable smell. The stalks are terminated by umbels of white flowers; the seeds are small and channelled, and are similar to those of aniseed. It flowers in June, and the seeds ripen in August.

This plant, though it has been administered in larger proportions for medicinal purposes than belladona, is still a strong poison, and produces effects on the stomach and nervous system, similar to other narcotic substances. As a remedy, the cicuta has been usefully administered in cancer, scrofula, chronic rheumatism, obstinate coughs, slow inflammatory affections of the lungs, and in some convulsive disorders. This vegetable, therefore, notwithstanding its poisonous qualities, may be considered a valuable acquisition to the materia medica.

The *Æthusa Cynapium, Lesser Hemlock,* or *Fool's Parsley,* is sometimes mistaken for garden parsley, by which accidents have not unfrequently been occasioned. It may be distinguished by the following character:—the upper surface of the leaves is shining, and of a darkish green colour, diffusing no odour when entire, but when rubbed between the fingers, producing a smell which is extremely offensive. The lesser hemlock is very poisonous; it causes vomiting, intoxication or delirium, numbness of the extremities, and often death.

The *Cicuta Virosa Aquatica,* or *Water Hemlock,* is a much more active poison than either of the above two species, and, in the opinion of Dr. Male, is the strongest of the vegetable tribe peculiar to Great Britain. It is often eaten by mistake for the wild smallage, or wild celery, as both grow in the same places, and are frequently to be met together in rivulets, and in wet marshy grounds. But the two plants may be thus distinguished—the leaves of the water hemlock are deeply divided quite to the pedicle, into three long and narrow *sharp pointed* segments; whereas those of the smallage are only slightly cut in three roundish *obtuse* segments. In Norway, the water hemlock has been considered so strong a poison to man and brutes, that its use as a medicine has been prohibited, and yet goats and swine eat it with impunity, which exemplifies an observation made in a former paper; namely, that we have in reality no vegetable substances which are universally poisonous. This plant, when swallowed, occasions convulsions, and rapid death, but produces no sickness, nor any affection of the stomach and bowels. The smell of it, in a close place, occasions giddiness and a head-ache.

The *Hyoscyamus*, or *Henbane*, in small doses, is a valuable medicine, possessing narcotic powers little inferior to opium, for which it is often substituted. This plant has long tapering roots, which strike deep into the ground. These send out in the spring, erect, branched stems, about three feet in height, with large soft leaves of a sea green colour, deeply slashed in their edges. The flowers, which appear in June and July, are of a straw colour, beautifully pencilled with a net work of purple veins, terminating in globular capsules closed with a convex, smooth lid; the capsules containing cells which are filled with small irregular seeds. The whole of this plant has a strong, disagreeable, and narcotic odour; but scarcely making any impression on the tongue. It grows in waste grounds, on the sides of roads, and particularly in calcareous soils. The seeds, leaves, and root of this plant, as well as of all the other species of this genus, are poisonous; producing, in some instances, delirium, convulsions, and death in a few hours after they have been taken; and as the root has sometimes been mistaken for parsnips, and used for soup, too much care cannot be observed in guarding against such accidents. So active is this poison, that even a plaster prepared from it has occasioned a trembling of the limbs, and intoxicating symptoms; and yet the hog takes it occasionally, without any bad effect.

The *Datura Stramonium*, or *Thorn Apple*, which lately has been brought into public notice from its affording relief in asthma, and in some other pulmonary affections, (though originally from America,) is now indeginous to this country; and is a plant, or rather weed, very commonly found on the refuse of gardens, and even on the banks of our hedges. It is an annual, sending up a thick, round, branching stalk, from two to three feet in height, with large irregularly ovate leaves, pointed at the extremity, of a dark green colour. Its flowers are white, of a full size, and appear in July and August. In its recent state, it has a bitterish taste; and when rubbed between the fingers, a smell somewhat resembling that of the poppy. Like other narcotics, a full dose brings on vertigo or giddiness, dilatation of the pupil of the eye, head-ache, drowsiness, difficulty of swallowing, and when taken to excess, delirium, convulsions, and death.*

The *Laura Cerasus*, or *Common Cherry Laurel*, must be too well known to render it necessary to enter into an account of its natural history and external character, since it forms one of the leading ornaments of our domestic shrubberies, and its leaves are in common use for culinary purposes. But it is of great importance to be acquainted with its deleterious qualities, and to be upon our guard against a too free use of a shrub, that, under certain processes, is capable of being rendered the most active poison which this country produces. The leaves of this shrub have a bitter, styptic taste, accompanied with a flavour resembling that of bitter almonds. The flower also manifests a similar flavour. The powdered leaves applied to the nostrils, excite sneezing, though not so strongly as produced by tobacco. The kernel-like flavour, which these leaves impart, from being generally esteemed grateful, have occasioned their being employed for culinary purposes in the making of custards, puddings, and the like; and as the mucilaginous quality of the other articles used, are calculated to counteract their deleterious quality, and as the pro-

* For the treatment of this and the preceding narcotic vegetable poisons, see the article—opium.

portion of the leaves so employed is very small, they have seldom been productive of any very serious effects. The smell and flavour of laurel water very strongly resembles the bitter almond, the essential oil of which, as well as of every bitter kernel, from containing prussic acid, is most actively poisonous. From a similar cause, the laurel leaf derives its deleterious quality; and hence its essential oil, undiluted, produces instantaneous death, like the fatal fit of apoplexy; which renders it the most terrible and deadly poison at present known. If taken with distilled water, its effects are also quick, though less rapid than in the former instance. Its operation is confined principally to the brain and nervous system, affecting but little the stomach; producing convulsions, tetanus, palsy, and ultimately, fatal apoplexy.

The only case with which I am acquainted in which a preparation of this shrub has been feloniously administered as a poison, was in that of Sir Theodosius Boughton, who was poisoned with laurel water, in the year 1780. The dose administered, was about two ounces, which, by the offender, was substituted for an aperient draught that had been ordered by the apothecary; the former of which was given to him unconsciously by his own mother, Lady Boughton. In two minutes after the dose had been taken, Lady Boughton states in evidence, that her son struggled hard, and could with difficulty keep it down. He had a prodigious rattling in his stomach and guggling, and these symptoms continued about ten minutes. Perceiving him a little composed, she went out of the room, and returned in about five minutes; when to her great surprise, she found him with his eyes fixed upwards, his teeth clenched, and foam running out of his mouth; and he died in two hours from the time of taking the poison.

Dr. Parsons, then professor of anatomy at Oxford, who was called upon to give evidence, stated as a proof of the activity of the laurel poison, that a girl eighteen years of age, in perfect health, who by mistake had taken less than two table spoonsful of the first runnings of the simple water of laurel leaves, within half a minute fell down, was convulsed, foamed at the mouth, and died in a short time. And Dr. Ashe reported, that a tea spoonful of the essential oil would destroy animal life in a few seconds.

Dr. Male, in his treatise on Medical Jurisprudence, mentions, that two ounces of the water distilled three times, killed a middle size dog in less than half a minute, even while it was pouring down his throat; and that laurel leaves, simply beat into a pulp, possess a deleterious quality; and yet the strongest decoctions or infusions of them, will be taken by horses with impunity, even when given to the quantity of a pailful; so variously do poisons act upon different animals.

The doctor fully confirms the poisonous quality of the bitter almond, the basis of which, like that of the laurel, is prussic acid; and states that the smallest proportion inserted into a wound produces death; and Dr. Brodie, in the Philosophical Transactions, has given some interesting experiments of the oil of bitter almonds upon animals, illustrative of its destructive operation on the animal system. Laurel water, combined with other articles, is not unfrequently put into insipid wines, to give them a flavour.

For the treatment, Dr. Orfila recommends first, active vomits; next, very strong infusions of coffee; and lastly, bold and large doses of the oil of turpentine administered in coffee, at intervals of three or four hours.

The *Nicotiana Tabaca*, or *Tobacco*, is too well known to need description, and its narcotic effects are daily experienced by those not accustomed to its use. Differing from the other narcotics when taken internally, it acts as powerfully on the stomach and intestines, as upon the brain and circulating system, producing great pain in the abdomen, active vomiting and cholera, followed by vertigo, delirium, a dilated pupil of the eye, great variations in the pulse, convulsions, and death. The same effects have been produced by a decoction applied externally, or by an ointment to an open surface; and excepting where habit has rendered it less deleterious, tobacco may be considered in all instances a very active poison. Santieul, a celebrated latin author, who was born at Paris, in the year 1650, according to Dr. Orfila, was killed by an inconsiderate person emptying the contents of a snuff box into his wine; which as soon as he had swallowed, threw him into a great agony, and put a period to his life in four hours. Many other instances might be adduced, of accidents occasioned by the indiscreet use of tobacco in its simple state, or when prepared into snuff; though both, from the force of habit, are daily consumed in very extraordinary proportions and apparently with impunity; but how far without ultimate injury to the constitution, is a matter which experience alone can decide.

The *Digitalis Purpurea* or *Fox Glove*, is well known by its beautiful flowers, which adorn our banks and hedges; and the plant lately, under an improved cultivation, has been introduced into our gardens. Its external character indeed is now so familiarly understood, that a particular description seems hardly necessary. Its leaves, which are the most active part of the plant, though the whole is poisonous, are large, oblong, egg-shaped, covered with hair, and serrated; they have a bitter, very nauseous taste, with some acrimony. Its flowers, which are somewhat bell-shaped, are of a purple colour, and mottled within; being generally attached to one side of the stem, from which they hang in a pendulous form, and often in clusters. The medicinal effects of digitalis, are a diminution in the frequency of the pulse and in the irritability of the whole system, and an increase in the action of the absorbents and in the secretions in general. Hence it has been a most useful remedy in inflammatory complaints, pulmonary affections, hæmorrhagy, scrofula, dropsy, and in some cases of mania. In too large doses, it produces great pain in the stomach, vomiting, cholera, impaired vision, vertigo, delirium, hiccup, a cessation of arterial action, convulsions, aad death. It has, therefore, deservedly been ranked among the active poisons, and when taken to excess, is to be treated in the same manner as an over dose of opium to be hereafter detailed.

Aconitum, Monk's Head, or *Common Blue Wolfsbane*, though used by some physicians as a medicine, is in reality a very active poison, possessing a caustic and suffocating quality, by which swallowing is immediately affected, and the stomach is corroded. We have, therefore, already ranked it among the acrid poisons; but as it possesses narcotic qualities also, we have deemed it necessary to notice it more particularly in this place.

This plant though a native of France, Germany, and Switzerland, has been introduced into our gardens for ornamental purposes. It is perennial, having many stalks arising from one root, with alternative petiolated leaves divided into five parts, each portion being cut into linear segments; to the leaves are attached terminal branches of irregular blue flowers with five petals, many stamina, and three pistils, succeeded by three capsules containing seed. When the plant is first gathered, it has a strong smell, but no peculiar taste. Each part of it, but especially the roots, is one of the most virulent of the vegetable poisons. Too large a dose occasions a very painful sensation in the tongue and jaws, with difficulty in swallowing, violent heat in the throat, pain in the stomach, most active vomiting, and cholera, giddiness, fainting fits, cold sweats, convulsions, and death. The juice of the plant was formerly used by savage nations for the purpose of poisoning their arrows.

The treatment consists of actively clearing the prima viæ, plentiful dilution with milk and other demulcent fluids, a large proportion of the whites of eggs beat up and taken frequently, a free use of a very strong infusion of coffee, and if pain and tension of the abdomen supervene, the application of twelve or fifteen leeches to the part affected, followed by fomentations and saline diaphoretic medicines; or if great debility and nervous depression ensue, volatile alkali in large doses, ether, wine, and other cordials.

The seed of the berries of the *Strychnos*, more commonly known by the name of *Nux Vomica*, which is brought from the East Indies, is a very active poison, and particularly so to dogs and to the brute species in general; though it has been used on the continent in moderate doses for various diseases, which there, it has had the reputation of curing. In this country, it has rarely been prescribed. It is one of the articles employed in the adulteration of fermented liquors, to which it imparts an intoxicating, and we may add, a very poisonous quality. When taken in an overdose, nux vomica produces very rapidly a general torpor of the system, nervous tremblings, coma, convulsions, tetanus or locked jaw, and death; its action being confined principally to the brain and nervous system, and affecting but little the stomach and intestines.

The *Cocculus Indicus*, a berry well known in this country, is also a narcotic poison, frequently put into porter to impart to it an inebriating quality, and though by no means so active or so dangerous as the nux vomica, yet it is a very improper article to be used for such purposes.

Camphor, the exuded juice of the *Laurus Camphora*, which is imported from Japan and which in the hands of a skilful physician is a most valuable remedy, if taken in overdoses, or improperly administered, is an active poison, producing nearly the same train of symptoms as the two former articles, with the addition of great pain and heat in the stomach, and throughout the whole of the intestinal tube.

For the treatment of the last three poisons, Dr.

Orfila recommends an active emetic, the inflating the lungs by artificial means, and the administering a draught every ten minutes, composed of two ounces of water, one drachm of ether, two drachms of oil of turpentine, and half an ounce of sugar.

We come next to a class of substances partly partaking, in a chemical sense, of the vegetable, partly of the animal character, which, from their poisonous quality, not unfrequently give rise to fatal accidents, and therefore deserve a particular notice in this place. We allude to the agaric species, or *false mushrooms*; among which the *Agaricus Piperatus*, which grows near the stumps of trees, and the *Agaricus Muscarius* to be found in the open ground, are the most active. The former, from its situation may be easily known; but the latter sometimes can with difficulty be distinguished from the genuine mushroom.

The following rules, from the work of Dr. Orfila, may be useful in detecting poisonous mushrooms:—

"Mushrooms, which grow in thick forests where the light of the sun does not penetrate, are in general *bad*. Their surface is moist, more or less dirty, and they have a disagreeable appearance. Those which are heavy, with a moist surface, nauseous smell, and which, on being cut, present different colours, changing from time to time, and found in shaded places, are also to be rejected.

The same may be said of those which grow quickly, and decay immediately; of those bitten and abandoned by insects; and of those with a soft stalk, and covered with patches of skin."

The *Agaricus Muscarous*, which Dr. Orfila does not appear to have noticed, from often being mistaken for the true mushroom, is deserving of a more particular description; and which, from being peculiar to Great Britain, may not have been brought within the doctor's observation.

In this species, the pillar stalk is white, thick, and hollow, thicker towards the top; egg-shaped at its base; surrounded at its middle with a pendulous membrane, and furnished with a cap, which is large, sometimes six inches or more in diameter; almost flat; and either beset with angular downy, or by white or red, warts. The gills are white, flat, or inversely spear shaped; the greater number extend from the rim of the cap to the stalk, the rest only half way. When this mushroom is decaying, the gills become brownish. It is found in pastures and woods.

The true mushrooms, on the other hand, may be known by *their external whiteness*, and by being *of a pale red* within, when young, and *a deeper red*, when older. They are at their first appearance, of a round figure, with short and thick stalks, and are not much larger than a small nut. After they have a little unfolded their membranes, they appear within red, full and close; their caps very smooth, soft, and white. They grow in meadows and commons that have a rich soil, and sometimes to a very considerable size; in which case the cap becomes flattened, broad, umbrageous, and the lines within are regular to the stalk and of a deep chocolate colour.

To try the purity of mushrooms, it is recommended to boil with them an onion with the outer coat removed; and should the onion become blue or black, the former is to be discarded as dangerous. If the onion remain white, the mushroom may then be considered good and fit for use.

Whole families are sometimes poisoned, and numerous persons (as we know from daily experience,) have their health most seriously injured by the eating of unwholesome mushrooms. And although we may attribute these effects occasionally to an excessive use, or rather to an abuse, of those which are not deleterious; yet we cannot be too cautious in our selection of this luxurious but very dangerous article of diet, as many of the species are rank and positive poisons.

The general effects of poisonous mushrooms are nausea, great heat and pain in the stomach and intestines, followed by vomiting and cholera, fainting fits, a small, hard, and frequent pulse, delirium, stupor, cold sweats, and if no relief be obtained, death.

The treatment consists of a quick and decisive vomit, followed by a full dose of castor oil, sulphate of magnesia, or of any other suitable aperient; and succeeded by frequent doses of ether in combination with the volatile alkali, fomentations to the abdomen, and demulcent drinks. Should inflammatory symptoms supervene, the free use of leeches, and the substitution of saline diaphoretics for the cordial remedies, are to be resorted to.

The most important, however, of all the narcotic vegetables, and the one most frequently productive of accidents, is the inspissated *juice* of the *Papaver Somniferum*, or, as it has been termed more familiarly, *Opium*.

This article is imported from Persia, Egypt, Smyrna, and other parts of Levant, and from the East Indies, in cakes from four ounces to a pound in weight; and is prepared from the poppy in the following manner, as related by Mr Ker, in Dr. Crump's dissertation on opium.

"The seeds are sown in quadrangular area, the intervals of which are formed into aqueducts for conveying water to each area. The plants are allowed to grow six or eight inches from each other and are plentifully supplied with water until they are six or eight inches high; when a nutrient compost of dung, ashes, and nitrous earth, is laid over the area. A little before the flowers appear, they are again well watered, till the capsules or heads of the poppy are half grown; when the watering is stopped, and they begin to collect the opium. This they effect, by making at sun set, two longitudinal incisions of the capsule from below upwards without penetrating the cavity, with an instrument which has two points, as fine and as sharp as a lancet. The incisions are repeated every evening until each capsule has received six or eight wounds, and they are then allowed to ripen their seeds."

"The juice which exudes, is collected in the morning, and being inspissated into a proper consistence by working it in an earthen pot in the sun's heat, it is formed into cakes for sale."

"This article is often adulterated by the addition of other substances which are kept a secret; but it has been ascertained that these extraneous additions have seldom exceeded one part and a half out of twelve of the opium imported into this country."

Genuine opium is of a reddish brown colour, and possesses a strong, peculiar smell, and a nauseous, bitter, and acrid taste, followed by a slight warmth in the mouth. It dissolves in water, in wine and in alcohol, and it readily blends with solid substances, thus admitting of a variety of pharmaceutical preparations, so as to meet the views and intentions of the prescribing, physician, when used as a remedy.

Considered as a medicine, opium may deservedly be ranked among one of the greatest blessings.

conferred on mankind; since there are few diseases in which it does not afford some relief; many very painful and dangerous maladies it rapidly cures; and in lingering and hopeless cases, it seldom fails to suspend the more violent symptoms, and to render the afflicted patient as easy and as comfortable under his sufferings, as the nature of his complaint will admit.

When taken or administered as a poison, it has usually been swallowed in its pure solid state, or simply dissolved in wine or spirits under the familiar name of laudanum; and when suicide is decided upon, this poison is often preferred, from the *mistaken* notion that death will follow without being preceded by pain or a consciousness of its effects; or, in other words, by its producing immediate and fatal sleep, from which the individual can never again be roused. Owing to the resemblance of laudanum in its colour to tincture of rhubarb, and to some other pharmaceutical preparations, (particularly should the bottle in which the article is contained be without a lable, or have received an erroneous designatiou,) it is also not unfrequently taken by mistake; and as the medicines which it resembles, are generally nauseous, the whole is commonly swallowed before the error has been detected.

In those countries in which opium is produced, and where the prevailing religion prohibits the use of wine, as in Turkey, in the Barbary States, in

Egypt, and throughout a large part of Hindoostan and other portions of Asia, opium, by progressive habit is swallowed in very large proportions in the solid form, to the amount of half an ounce or more each day, without producing any other effect than that of temporary inebriety; and we know of many instances of its being taken with extraordinary freedom in this country by persons who have gradually accustomed themselves to its use. This practice, however, cannot be too sufficiently deprecated; since by enervating the system, it renders it more susceptible of the attacks of disease, and by accustoming the constitution to its use, it effectually deprives the individual of a remedy, which, when required, is the most efficacious perhaps of any in the whole materia medica. Under ordinary circumstances, great circumspection, in the administration of this very powerful drug is required, so as to adopt its proportions to the constitution and state of health of the individual for whom it has been prescribed.

A *moderate dose* of opium for an adult, in the solid form, is from a grain to a grain and a half; or when given in solution under the title of laudanum, from twenty to thirty drops; *a full one* may be rated at from two to two grains and a half the solid; or from forty to fifty drops of the liquid opium; *a large dose,* from three to four grains of the former, or sixty to eighty drops of the latter; every dose beyond, is to be considered unsafe and dangerous; bearing in recollection, that the smallest dose mentioned may, in some instances, prove too powerful; and that the largest proportion, should never be administered, but in cases of great urgency, and should always be subjected to such management as will guard against the possibility of accidents. The exact quantity, that would certainly prove fatal to the human subject, could we ascertain the fact, it would answer no useful purpose to mention. Fortunately it often happens, that a very large proportion cf laudanum, by occasioning immediate and active vomiting, proves its own cure; and thus frequently saves the life of the patient before medical aid can be obtained. When this effect is not produced, or when the vomiting occasioned by the poisoning is not sufficient to afford the desired relief; so far from sleep and exemption from pain being the result, the most distressing and the most afflicting train of symptoms generally supervene. Perpetual nausea, constant and unavailing retching, pain and great uneasiness at the region of the stomach, excessive giddiness, with weight and *excruciating* pain in the head, much bodily anxiety, and alarming mental depression, followed in a few hours by delirium, convulsions, stupor, apoplexy, and death, are the fatal consequences of an over dose, or of a wicked administration of this poison; effects which cannot be too strongly impressed on the minds of those, who, from not possessing the resolution to meet the evils of life with becoming fortitude, are bent on self destruction; or who in the contemplation of murder may have sufficient humanity to avoid this most cruel and most cowardly means of accomplishing their object. In the treatment of the poisonous effects of opium, the first object is to relieve the stomach of the offending matter as effectually and as speedily as possible by administering a quickly operating and active emetic. The sulphates of zinc and copper in suitable doses are the most speedy in their operation; next a combination of tartar emetic and ipecacuanha; or should these not be at hand, the irritating the throat with a feather; or a tea spoonful of flour of mustard in a glass of water very frequently repeated, are to be given, so that by some means or other active vomiting be induced as early as possible; and then, a suitable aperient can be taken with advantage.

After these remedies, the free use of acids, as lemonade, vinegar and water, oranges, and the like, may *for the first time* be administered, and in very considerable proportions; it having been ascertained that acids given before the primæ viæ be well cleared, have a very dangerous tendency, by dissolving and adding increased activity to such of the poison as remains in the stomach. A very strong infusion of coffee in the proportion of eight ounces to a quart of boiling water, has been found to be of great use, by giving a cupful alternately with an acid drink;

and when the pulse flags and stupor intervenes, full doses of volatile alkali, ether, brandy and water, blisters, sinapisms to the feet, and other stimuli, and frequent rousing of the patient from his lethargy must be resorted to, under the hopes of keeping up the arterial action, before a fatal exhaustion has taken place.

I shall conclude my account of the narcotic poisons by introducing to your notice, the *Prussic Acid*, which, though derived principally from animal substances, is one of the strongest narcotic poisons probably in nature; and in activity and virulence, takes the lead of all the other poisons.

This acid, which is composed of hydrogen, nitrogen, and carbon, is prepared from dried blood, or the horns or hoofs of animals by distillation with fixed alkali; or it may be obtained by decomposing the prussian iron or stone blue, of which it forms one of the constituent parts.

The prussic acid exists in the form of a colourless fluid; and has a strong odour resembling that of the peach tree blossoms. When in the state of vapour or gas, it is very volatile and inflammatory; and it has an acrid and acid taste, though possessing very few of the other properties of the acids. It exists in a natural state in bitter almonds, the kernels of apricots, the leaves of laurel, and in peach blossoms, and in Germany, it has lately been discovered in opium; from which we may conjecture, that all narcotic vegetables possess a portion of this acid. It has also been found in the mineral kingdom, in combination with iron. It is easily decomposable at high temperatures; and becomes converted into ammonia, carbonic acid and carburetted hydrogen gases.

Of its poisonous qualities, Dr. Majendie has given us some interesting illustrations in the eighth number of the Journal of Sciences and Arts, in the following experiments :—

"First. The extremity of a glass tube, which had been previously dipped into a vial containing some pure prussic acid, was immediately plunged into the throat of a strong dog. The tube had scarcely come in contact with the tongue, than the animal made two or three long and rapid inspirations, and fell dead. No method we could devise, enabled us afterwards to trace the smallest signs of sensibility in the muscular organs of this animal after death. Second. An *atom* of the acid was applied to the eye of another dog: these effects were as sudden and as fatal as in the preceding. Third. A drop of the acid diluted with four drops of alcohol, were injected into the jugular vein of a third dog. The animal fell dead that instant, as if struck by a cannon ball or by lightning."

"The doctor is of opinion, that the pure prussic acid, as prepared by Mr. Guy Lusac, is undoubtedly of all the known poisons, the most active and the most promptly mortal."

Monsieur Robart, of Rouen, states, that the gas of the prussic acid in combination with atmospherical air, when confined in a closed matrass, has a very powerful effect upon animals; which he illustrates by the following experiments.

" First. The bill of a bird being applied to the orifice of the matrass, the animal died in an instant. Second. The mouth of a young rabbit twenty-five days old applied to the orifice of the same matrass which was corked after each experiment, the little animal died in less than half a second, with the mouth open, and discharging a great quantity of saliva. Third. A cat, six months old, being applied in a similar manner to the orifice of the same matrass, made some effort to withdraw itself; but *in two seconds*, it died with the same symptoms as in the second experiment. Fourth. An old but healthy spaniel was applied to the orifice of the matrass, so that the nostrils only were exposed to the vapour; it made several efforts to escape from its painful situation but in *six minutes* fell down and died in the manner already described. Fifth. A much stronger dog which had not *eaten for twelve hours* being submitted to the same experiment, died in a similar manner in *less than six seconds.*

From these five experiments, Mr. Robart observes, " we may conclude that a matrass of the capacity of two litres full of prussic acid gas, mixed with atmospheric air, is sufficient to demonstrate the deleterious nature of that gas; and that its injurious quality is not sensibly modified by admixture with atmospherical air."

The following experiments were afterwards made with the liquid prussic acid. "First. A rabbit, five days old, being forced to swallow a grain by weight of this liquid, the little animal uttered a cry, and *died in a second.* Second. A coffee spoonful of the acid was given to a very strong dog. The animal uttered a very strong cry, and instantly expired."

"These two experiments prove the deleterious nature of the liquid acid; but comparing the promptness of the effect, the gaseous acid, even when mixed with air, appears to act more powerfully than the liquid acid."

His next experiments were made with the prussic acid dissolved in alcohol. "In experiment the first, a young rabbit was forced to swallow a coffee spoonful of this alcohol, when it exhibited symptoms resembling those of intoxication. It remained for some minutes without motion; but soon recovered all its vigour, as if nothing had happened. Concluding that the preparation was imperfect, he repeated and altered the process; and then caused a strong dog to swallow two drachms of the liquid, which threw him in *two seconds* in strong convulsions, and he died in five minutes."

From these experiments Monsieur Robart concludes, "that the prussic acid gas is the most promptly poisonous of the three preparations; next, the liquid acid; and lastly, the prussid acid dissolved in alcohol."

In the course of his observations, Mr. Robart notices a chemist in Germany, who had made a preparation of the prussiated alcohol, which bore some resemblance to laurel water. "The chemist shewed this liquor to some friends who were dining with him; and, on leaving the room, forgot to carry it away. The servant on clearing the table finding this liquor agreeable to his palate, drank a small glass full of it, and died in two minutes as if struck down by apoplexy."

"In examining after death the animals upon whom these experiments were made, it did not appear that any material mischief had been done to the important organs. The leading features, were the very dark and dirty appearance of the blood in the large vessels, and the powerful and prevailing smell of the prussic acid, which emanated from every part that came under observation.

In addition to the proof we have already given of its destructive effects on the human constitution, as exemplified in the unfortunate servaut who inadvertently took a small glass of it; we may adduce a case noticed by Huffeland, who mentions, that a robust man, aged thirty-six years, at the moment when he was about to be taken up as a thief, seized a small sealed vial which he had concealed in his pocket, and breaking off the neck, swallowed the greatest part of the fluid contained in it, which was about an ounce in quantity. It spread such a strong smell of bitter almonds, as almost to stupify every one present.

The man staggered a few steps and then without a groan fell upon his knees, and sunk to the ground. A physician being sent for, found him quite lifeless, and without the least traces of pulse or breathing; and though in a few minutes afterwards, slight expirations with convulsive motions about the chest were observable, yet the vital spark was evidently extinguished in a very short time after his taken the poison. In this case, as in the other, every part of the body, omitted a very strong odour of bitter almonds, which discovered at once the nature of the liquor that had been swallowed, and which odour, during the dissection, was almost too powerful for the operator to bear. Another instance of poisoning by the prussic acid, is mentioned by Orfila, when a girl took a small quantity of it, and fell dead as if struck by apoplexy.

From the above well attested facts ,we may conclude, that the prussic acid is the most prompt and the most active of all the poisons hitherto discovered. It however fortunately happens, that accidents cannot occur very frequently, since its use is confined principally to practical chemists, to whom it affords some valuable tests, and to a few medical men only, who are now administering it diluted in the most cautious manner, as a remedy for some very obstinate diseases; the results of which have hardly yet been sufficient to introduce it into general practice.

SYNOPTICAL TABLE OF THE DIFFERENT

POISONS,

Animal, Vegetable and Mineral,

From which Accidents most frequently occur.

ANIMAL POISONS.

(A.) Those which produce their effects only when introduced into the blood vessels.

POISONS.	SYMPTOMS.	TREATMENT.
POISONOUS SERPENTS. Crotalus—*Rattle Snake.* Cobra de Capello, and other foreign Serpents, whose bites endanger life.	Burning pain, rapid inflammation, swelling and discoloration of the wounded part, extending, if not speedily removed, to the other parts of the body, followed by delirium, syncope, convulsions, and death.	Immediate extirpation of, or an active caustic, to the wounded part, or both combined. If this be omitted, the assiduous application of equal parts of eau du luce, or spirits of ammonia and laudanum, or of salad oil, volatile alkali and laudanum. And internally, large and frequent doses of the carbonate of ammonia and oil of amber, and if the pulse flag, wine, brandy, and cordials of every kind.
Coluber Berus—*Viper.*	The same as the above, but not so rapid in their progress; or, in general, so fatal in their consequences.	Extirpation and caustic not necessary. The fat of the animal (if it can be obtained,) *assiduously* rubbed into the wounded part, or salad oil, and as soon as can be procured, the application of eau de luce and laudanum, or of spirits of ammonia, salad oil, and laudanum; and internally, (if required,) the remedies recommended for the bites of foreign serpents.*
POISONOUS INSECTS. Tarantula. Scorpio—*Scorpion.* Scolopendra.—*Centipede.* Vespa Crabo.—*Hornet.* Vespa Vulgaris.—*Wasp.* Apis.—*Bee.* Culex Pipiens.—*Gnat* Oestrus Bovis.—*Gad-fly.*	Pain, heat, inflammation, swelling, and discoloration of the wounded part, seldom affecting the constitution.	The same as recommended for the bite of the viper, with the exception of the first application.

* The Amber Draught.—Rub ten drops of the oil of amber and twelve grains of the carbonate of ammonia in a glass mortar, with a drachm of powdered gum arabic, and as much lump sugar; to which gradually add an ounce and a half of water, and let the draught be taken every four hours.

POISONS.	SYMPTOMS.	TREATMENT.
SALIVA OF THE RABID DOG, Or of other rabid Animals.	Occur at an uncertain time, between fifteen and one hundred days or more, by a renewed uneasiness, pain and swelling of the wounded part; and followed by great mental anxiety, langour, muscular spasms, disturbed rest, a dread and almost an impossibility of swallowing, producing convulsive spasms, in the organs of deglutition upon the approach of fluid or even solid substances to the mouth; a swelling and protusion of the tongue; a constant flow of viscid excretion from the mouth; delirium; general convulsions; and death.	Extirpation of, or the application of an active caustic to the wounded part, or the two combined, at any period before the secondary inflammation of the wound supervene. All other remedies uncertain, and therefore not to be depended upon.

(B.) Those animal substances which produce their poisonous effects only, when received into the stomach.

POISONOUS FISH. Tropical and European, including poisonous muscles, and such edible fish, as, in particular constitutions, produce poisonous effects.	Nausea, weight and fulness of stomach, vomiting, excessive pain in the abdomen, cholera, restlessness and anxiety, vertigo, fainting fits, flushing and burning of the face and whole body, general cuticular eruption, universal jaundice, convulsions, and death.	An immediate active vomit succeeded by a large dose of castor oil, or an active saline aperient, and followed by full doses of the carbonate of ammonia, ether, and opium, fomentations and the warm bath; and if inflammation supervene, by general and local bleeding, blistering, and cooling remedies *
CANTHARIDES. *Spanish Fly.*	Fetid breath, acrid taste, burning heat in the mouth, stomach, and whole intestinal canal, excessive pain and inflammation of the stomach, kidneys, and bladder, delirium convulsions, and death.	Copious dilution with linseed tea, barley water with gum arabic, (an ounce to a quart), milk, sweet oil mixed up with sugar and water, fomentations, the warm bath, general and local bleeding, and opium, when required.

* In all cases of poisoning, no time should be lost in calling in medical advice; and when it is of importance to empty the stomach immediately, the stomach pump, which should be in the hands of every medical practitioner, ought to be used, as being more prompt in its operation than emetics. When professional assistance *cannot* be procured, then the remedies in the order we have recommended to be resorted to; and if emetics are to be given, either for the animal, vegetable, or mineral poisons, the following are proper:—

Twenty grains or a scruple of ipecacuhana with two grains of emetic tartar; or three grains of emetic tartar alone; or twenty grains of white vitriol; or four grains of blue vitriol; are to be mixed in a wine glass full of water, and given every quarter of an hour until the effect be produced. If none of these articles be at hand, a tea spoonfull of the flour of mustard to be given in a glass of water every ten minutes; or copious draughts of weak chamomile tea; or warm water; or tickling the throat to excite vomiting.

VEGETABLE POISONS.

(A.) Acrid vegetable poisons, which produce their effect principally on the stomach, and the internal parts with which they first come in contact.

POISONS.	SYMPTOMS	TREATMENT.
Colchicum Autumnale.--*Meadow Saffron.* Colocynthis—*Bitter Apple.* Elaterium—*Wild Cucumber.* Euphorbium. Helleborus Niger. — *Black Hellebore.* Scilla Maritima.—*Squill, or Sea Onion.* Gamboge. N. B. Many other articles have been classed under the head of acrid vegetable poisons; but as they have been rarely productive of accident, it has not been deemed necessary to insert them.	Acrid taste, with heat, smarting, dryness and constriction of the throat, followed by nausea, vomiting, and excessive pain in the stomach and bowels, and active cholera. Vertigo, swelling, pain and tension of the abdomen; hurried and difficult respiration, muscular spasms, internal pain of the head, cold perspirations, dilated pupil, feeble pulse, convulsions, and death.	An active emetic, followed by plentiful dilution with mild demulcent drinks, as recommended for poisoning by cantharides; or if active vomiting commences, then the dilution without the emetic. This to be followed by a full dose of castor oil, or of epsom salts, after which, opium, ether, and camphor may be given; unless inflammatory symptoms supervene, in which case, general and local bleeding are to be resorted to, and other cooling means.

(B.) Narcotic vegetable poisons, which act principally on the brain and nervous system.

Papaver Somniferum—*Opium Laudanum.* Aconitum—*Wolf's Bane.* Belladona. — *Deadly Night Shade.* Conium Maculatum—*Common Hemlock.* Cicuta Virosa.—*Water Hemlock.* Æthusa Cynapium. — *Lesser Hemlock, Fool's Parsley.* Hyoscyamus.—*Henbane.* Datura Stramonium.—*Thorn Apple.* Laura Cerusus. — *Common Laurel.* Digitalis Purpurea—*Fox Glove* Solanum Dulcumara.—*Woody Night Shade.* Nicotiana Tabacum.—*Tobacco* Nux Vomica. Cocculus Indicus.	Distressing nausea followed by active vomiting, and general uneasiness about the stomach. Sense of numbness, stupor, pain and weight of the head, with feelings of intoxication, great general distress and anxiety, delirium, dilated pupil, followed by coma, palsy, convulsions and death.	Active vomits, followed by active purges; after the operation of which, (and not before) acid drinks, as lemonade, vinegar and water, imperial and acid fruits, alternated with strong infusion of coffee, in the proportion of half a pound to a quart. Apopletic symptoms to be relieved by local bleeding, blisters, general frictions, and by every means that can rouse the nervous system.

POISONS.	SYMPTOMS.	TREATMENT.
POISONOUS MUSHROOMS.	Nausea, sense of heat, weight and great pain in the stomach and intestines, followed by vomiting and cholera, fainting fits, delirium, stupor, cold sweats, and if not relieved, by death.	Active vomits to be succeeded by full doses of castor oil, or of epsom salts; demulcent drinks as in cantharides, fomentations, the warm bath, frequent doses of the carbonate of ammonia and ether; and if inflammation supervene, general and local bleeding, and saline cooling remedies.
PRUSSIC ACID.	This acid, if taken beyond the smallest proportion, namely, a few drops, (and even that quantity endangers life,) produces instantaneous death.	Active emetics, followed by full doses of oil of turpentine, ether, brandy, ammonia, blisters, frictions, and other stimuli, calculated to rouse the nervous system.

MINERAL POISONS.

These act by destroying the parts with which they come in contact, or so injuring them, that the more remote organs are fatally affected.

(A.) METALLIC POISONS.

ARSENIC.	A strong, metallic taste in the mouth, with a sense of burning heat in the throat, nausea, and violent retchings, excessive burning and pain in the stomach and bowels, with cholera, and often a discharge of blood; sometimes a swelling tension and acute pain over the whole abdomen, great anxiety and distress in the countenance, excessive thirst, and a hot dry skin; a small quick, and irregular pulse; coldness of the extremities, cold sweats, fainting fits, convulsions, and death.	An active emetic, the vomiting to be encouraged by copious draughts of sugar and water, milk, and other demulcent drinks as in cantharides. Lime water and chalk and water may also be drank freely, the bowels to be opened by castor oil; and if inflammatory symptoms supervene, to be speedily treated by general and local bleeding, fomentations, the warm bath, blisters, and saline cooling medicines.
MERCURY. Corrosive Sublimate.	Very similar to those of arsenic.	An active emetic, and immediately after, copious proportions of the whites of eggs beat up with milk or with water. Milk, linseed tea, barley water with gum arabic, followed by a dose of castor oil as in cantharides; and in case of inflammation, general and local bleeding and blisters, according to the circumstances of the case.

POISONS.	SYMPTOMS.	TREATMENT.
SILVER. Nitrate of Silver, or Lunar Caustic.	Very similar to the above two poisons.	The same as for arsenic. A solution of common salt in one of the demulcent drinks, may also be given to decompose the poison.
ANTIMONY. Emetic Tartar.	The most distressing vomiting and cholera, spasmodic constriction of the throat, excessive pain in the stomach and bowels, great prostration of strength, quick small pulse, hurried and anxious breathing, and if not relieved, death.	First, large draughts of mild demulcents, as milk, barley water, linseed tea, &c. as in cantharides; and next, decoctions of oak or willow bark, gall nuts, or *very strong* tea, to decompose the poison; and if vomiting be not allayed, full doses of opium.
COPPER. Verdigris. Food cooked in foul copper vessels, or pickles made green by copper. Blue Vitriol.	Acrid, coppery taste in the mouth, and coppery eructations, constriction of the throat, nausea, vomiting of a greenish matter, severe retching, great pain in the bowels with cholera, abdomen distended and painful, small pulse, cold perspirations, convulsions, and and death.	Large draughts of milk and water, and other demulcent drinks as above. Sugar and water, whites of eggs beat up with water, and taken plentifully. Strong infusion of coffee made very sweet, afterwards free doses of opium; and if inflammatory symptoms supervene, to be treated by depletion, as before recommended.
LEAD. Sugar of Lead. Goulard Water. White Lead. Red Lead. Wines sweetened by Lead.	A sugary, astringent, metallic taste, constriction of the throat, colicky pain in the stomach and bowels with obstinate obstruction, often severe vomitings, sometimes of blood, hiccup, convulsions, and death; or if the patient survive, frequently paralytic affections.	Frequent doses of epsom salts in demulcent drinks, to promote vomiting and decompose the poison; opiates, the warm bath, large doses of castor oil with or without opium, until the obstruction be removed. Inflammatory symptoms to be treated accordingly.

(B.) ACID POISONS.

SULPHURIC ACID, Or, Oil of Vitriol. NITRIC ACID, Or, Aqua-fortis. MURIATIC ACID. Or, Spirit of Salt. OXALIC ACID, Or, Acid of Sugar. Any of the other mineral Acids taken to excess.	Very sour taste and burning pain and heat in the mouth, throat, and down the whole alimentary canal; fetid eructations, vomiting of a bloody fluid which effervesces with chalk, or any of the alkalies; great pain in the stomach and bowels with bloody cholera. small irregular pulse, great thirst, tension of the abdomen, hiccup, cold perspirations, convulsions, and death.	An ounce of calcined magnesia to be mixed in a quart of water, and a cupful to be taken every eight or ten minutes. If not at hand, soap, or chalk and water, or weakened lime water. To be succeeded by demulcent drinks, as in cantharides; and if inflammation supervene, by depletion. If the sulphuric acid has been taken, common magnesia and water is to be preferred to the calcined; and if oxalic acid, chalk and water.

POISONS.	SYMPTOMS.	TREATMENT.
	(C.) ALKALINE POISONS.	
POTASH. — SODA. — AMMONIA. Or, Volatile Alkali.	An alkaline caustic taste in the mouth, great burning pain in the mouth, throat, and stomach, nausea and vomiting of blood, cholera, sometimes of blood; an acute pain in the abdomen and bowels, delirium, convulsions and death.	Vinegar and water, lemon juice and water, and other vegetable acids taken freely; afterwards demulcent drinks, as in cantharides; and if inflammation come on, depletion and cooling medicines.
	(D.) ALKALINE EARTHS.	
LIME. — BARYTES.	Violent vomitings and cholera, great pain in the stomach and bowels, tension of the abdomen, vertigo, coma, palsy, convulsions, and death.	Vinegar and other acids with water, followed by epsom or glauber salts, dissolved in a mucilaginous drink, and to be drank freely
	(E.) MISCELLANEOUS POISONS.	
NITRE, Or, Salt Petre.	Severe pain in the stomach and bowels, nausea, active vomiting, fainting fits, convulsions, small pulse, cold extremities, difficult breathing, delirium, pinched countenance, and death.	Emetics and demulcent drinks as in cantharides; fomentations; and if inflammation, to be treated as before recommended.
MURIATE OF AMMONIA, Or, Sal Ammonia.	Nearly the same as the preceding.	The vomiting to be encouraged by copious draughts of warm sugared water, demulcent drinks, and afterwards the irritations to be allayed by opium. The inflammation, if any, to be treated accordingly.
PHOSPHORUS,	Very similar to those of corrosive sublimate, and the mineral acids, with a hot taste of garlic in the mouth.	The vomiting to be encouraged by large draughts of magnesia and warm water; and oil or fatty substances to be avoided. Demulcent drinks may be given as in cantharides; and inflammation to be subdued by suitable remedies,
ALCOHOL. — Brandy, and all spirituous liquors. Wine, and excess of fermented liquors of any kind.	Intoxication, stupor, insensibility, with other symptoms of apoplexy.	An active emetic, to be repeated until the effect be produced; afterwards a full dose of epsom salts. If incapable of swallowing, the stomach pump to be used, and through

that the proper medicines to be administered. Cold applications to the head, which should be raised high; and if relief be not speedily obtained, the case to be treated as apoplexy. If the extremities be cold, warmth and friction to be used, and every means adopted to promote the circulation.*

* For popular purposes, the above detail, we hope, will answer every useful end; as it will enable individuals to act upon the emergency of the moment, when life may be preserved by a timely remedy administered in the first instance, and afterwards until medical advice can be called in. But should a more varied (though still compendious) account of the poisons be thought desirable, we can conscientiously recommend Stowe's Toxological Chart, and a very small pocket volume published by Cox and Son, in the Borough, under the denomination of Essay on Mineral, Animal, and Vegetable Poisons, to each of which we are indebted for much valuable information.

LECTURE VI.

ON THE HUMAN FACULTIES, MENTAL AND CORPOREAL.

In treating on the human faculties, I deem it incumbent on me to explain—it is *the fullest capabilities* and *the noblest propensities* of man I propose to illustrate; in order that by comparison, we may account for the elevated rank which he holds in the creation, and for the distinguished superiority he has attained over every other part of the animal kingdom.

His imperfections and his moral deficiencies, I shall refer to far more able commentators; and to the judgment *of Him*, who, alone knowing the different springs of human action, will no doubt consistently *with his sense of justice*, make due allowances for the frailties inseparable from his nature; and without which he would be nearly upon a level with the Divinity himself.

But before we proceed, I must trespass on your time, while I notice those circumstances in the natural world, through the operation of which, the human faculties are called into action;

and which, independently of other important purposes, appear to have been placed in the way of man, to compensate him for the deficiencies which so obviously predominate in his natural character.

Our experience has taught us that the world, as at present created, was not intended to give to man a negative place in its concerns; nor as, in the other parts of animated nature, simply to supply his wants as the necessities of the moment suggested; but that he should progressively, and by the dint of his own labour and ingenuity, discover the means, not only of obtaining subsistence, but also of occupying his mind in those various directions, that were to give character to his species; and by enlarging its powers, and increasing its knowledge, prepare him for the higher destinies which await him.

The globe, therefore, has not been constructed *internally* upon those simple principles, which might have been sufficient for a more limited creation; nor are the animals and vegetables that adorn its surface, exclusively adapted to the mere preservation of life; but admit of a diversity of *other applications*, the operation of many of which, cannot be brought within any of the natural laws that we are acquainted with; but require some superior agency to discover and call into use the capabilities of which they are susceptible.

Thus we find in the place of one homogeneous mass of which the crust of the globe *appears* to be composed, it is made up of a great variety of compound substances, capable of being applied by art and ingenuity to the most useful purposes; without which, civilization could never have been effected, nor would those arts and sciences, that now adorn the human character, and from which have emanated so many important occupations, have ever been accomplished.

The discovery of the more common metals, and the mode of working them, appear therefore to have been among the earliest of human acquirements; and this first gave rise to the invention of implements for agricultural and other purposes; and the various cavities in the rocks which offered shelter to man, and the contrivances of the more ingenious animals, would naturally suggest to him, that with stones, or earthy materials closely put together, a far more commodious retreat might be afforded him than from the simple arrangement of stakes or the boughs of trees rudely arched over; to which, upon the emergency of the moment, he might at first have resorted.—And hence, the origin of architecture.

Thus, through his earliest necessities, he acquired a knowledge of some of the contents of the earth, and of the capabilities of which they are susceptible. And thus, as his wants increased, and as his taste improved, that knowledge was progressively expanded and diversified until the arts have reached the perfection in which we now see them.

In the vegetable world in all its varieties and to increase the supplies of which agriculture was called into use, how few of its species *comparatively* do we find adapted to, or used for animal subsistence only; limited to which they would have been, had they been created merely for the preservation of the vital principles? And what a large proportion, in all their diversified species and parts, have been converted by the ingenuity of man to the most comprehensive purposes; thus producing occupations most essential to his happiness, and calling forth his inventive faculties to the utmost limits of their power? Our husbandry, our habitations, our arts in general, our navigation, and our commerce, chiefly depend upon the human application of vegetable substances according to their respective capabilities; thus confirming, in the most ample degree, the innate faculties of man, and the intentions of the Creator, that these should be called forth from those resources in the natural world, which he has prepared for their especial developement.

If we examine the *animal kingdom*, still more distinguished as it is for the variety of its species and for the diversity of their movements, we find the same capabilities of being useful to man, and the same incentive to human action, as in the other portions of the creation. For had not man's invention taught him the means of destroying, or of defending himself against the attacks of the offensive animals, his own species would soon have become extinct; and had he been ignorant of the mode of domesticating and calling into use the more timid ones, his food must have been limited to a vegetable diet, for which his constitution is not adapted; his body would have lost its best covering; those animal substances, which, independently of food and clothing, now contribute to his commercial prosperity, would have been withheld; and deprived of those beasts of burden which, at present facilitate his operations far beyond the means of his own physical powers, and without which, his agriculture and his trade would have been of no avail; he soon would have lost the great incentive to action by which his influence in the creation is preserved, and he would have fallen a prey to the first ferocious animal which accident had placed in his track.

If we advert to the agency of the *aqueous part of the globe*, and to the uses to which a knowledge of it has been applied; we have an equal illustration of the natural powers of the human mind, and of the necessities to which man was subjected, in order that they should be called forth into useful activity. For water is not his natural element; and all animals, taken in their simple attributes (of which uninformed man may be considered as one,) instinctively avoid what does not belong to their habits, or to which they have not been accustomed by the force of education.

The ocean, therefore, in all its terrific grandeur and sublimity, would present to him, previously to the developement of his mental faculties, and to that experience which might arise out of the exercise of them, nothing but an object of surprise and terror; and the storms to which it was subject, and too frequently their consequences, would still add confirmation to his apprehensions.

It would never have entered into his early contemplation, that this great mass of water contained within its boundaries, those vast supplies of food that now add variety to his table; and those saline particles, without the use of which no animal food can be relished. That by evaporation, it produced those aqueous vapours, which, by irrigating the soil, promote its fertility, without which, his ordinary subsistence could not have been obtained; or that its surface would be traversed by vessels of human construction, through the medium of which, communications would be opened with distant countries, from which the most important results might be derived. But he would only see in its aspect, a barrier to his excursive movements, and a threat that even this range of action (limited as it might be) would be still further contracted and reduced.

The noble rivers, which in their passage to the ocean, *now* collect the superfluous moisture of the soil, and by overflowing their banks irrigate it when become arid by previous evaporation, and which on various other accounts are so essential to the conveniences of civilized man; would in that case only appear to him so many additional obstacles to his movements, and the sources of personal danger or apprehension, when necessity drove him to their banks, or in the choice of two evils, to venture into their streams.

But he was not intended to remain long in this simple state of ignorance. His intuitive faculties and his observation would soon teach him, that the danger might be obviated; and that as large natural bodies were permitted to float on the surface of the water, some contrivance might be adopted by excavating those substances, (for working implements were of very early invention,) which would enable him to cross these streams, or to throw over them a more ready conveyance, which the surrounding forests would suggest to him as practicable. Hence the origin of boats, from which have emanated those noble vessels, that now so extensively navigate every sea to which human experience has afforded approach; and hence have been produced those beautiful edifices in the form of bridges, which open easy communication between parts of the country, many of which without them, would hardly have been rendered accessible.

Upon his becoming more familiar with the watery element, he would soon acquire a knowledge of obtaining that, which may now be considered one of his first necessities, a supply of fish; and this would be greatly facilitated by his acquaintance with navigation, thus affording him access to parts where they were to be found in the greatest abundance; while his further experience would teach him the use and preparation of salt, without which his food could not have been relished. The expansive power of steam from which so many important applications have resulted, though its discovery *comparatively* may be considered of recent date, may be adduced as another splendid proof of the operation of the natural elements on the human mind, and of the intention of the Creator that its faculties should be developed and exercised through their especial agency.

The atmosphere is the next portion of the creation to which we beg to call your attention, as confirmatory of the doctrine we wish to establish; namely, that man is made up of capabilities only, and that these alone can be called into exercise through the medium of instruction, and of the external circumstances by which he is surrounded.

Thus his earlier experience would teach him that animal life depended on atmospherical agency, since the vital principle is immediately destroyed when the air is withdrawn from the lungs. But he had not *then* acquired a knowledge of the *nature* and *properties* of this substance, or even of its existence, but from the effects produced; much less the cause of its pressing upon other bodies, which, when not sufficiently resisted, put them in motion; thus suggesting the invention of sails for the purposes of navigation, since brought to such perfection, and of windmills, now of the most comprehensive use. It was not be expected that the laws of this invisible agent should be understood during the early experience of mankind. It was consequently not until a vast collection of facts had been recorded, and the mind had made great progress in reasoning upon causes, it was finally ascertained, that the atmosphere was as much a substance as any tangible body, possessing elasticity, density, gravity, and fluidity; that it was composed of two or three distinct ingredients chemically combined; that it held in solution or in combination, various other substances, as the electric fluid, caloric, water, and terrestial exhalations; and that it entered into the composition of most other natural bodies; from *all* which circumstances, new sciences have emanated, and a variety of the most useful instruments have been invented: which, explaining the causes of the various atmospherical phenomena, have increased human knowledge, and removed from the mind those superstitious apprehensions, which many of them in former times had occasioned.

Keeping in view the same principle, the heavenly bodies, the last portion of the creation to be noticed, do not appear to have been formed merely to lighten the earth's surface, or to gratify a curiosity so naturally excited by the wonderful aspect which they present.

At the earliest period, we find their situation and movements led uninformed man to observe them; and *by their aid*, to ascertain the means of traversing those trackless countries, which without it would long have remained unexplored; and ultimately to venture upon *that ocean*, which, in his primitive state, he would rather have fled from, than approached. Hence the origin of mathematical and physical sciences.

But it was only under the slow operation of experience, assisted by the explanations of ingenious men at different periods, that the laws of the planetary bodies, and the applications of which they are susceptible, have been brought to the perfection in which we now see them; thus affording another characteristic proof of the means adopted by Providence to exercise the human faculties in the direction best calculated to render them useful.

But independently of all these causes as contributing to the improvement of the human mind, the physical peculiarities *of man himself* have had a wonderful effect in calling forth his intellectual faculties.—We allude to his want of protection to his skin, and to the deficiency in his natural means of defence.

There are few circumstances that so well illustrate the intention of the supreme Being, that man should depend upon his own resources, as the want of that covering and protection to his skin, which the necessities of his condition so urgently require. All other animals are provided in this particular according to their wants. To quadrupeds and birds, we find an ample covering has been given, suitable to the climate in which they are placed; and which serves as a protection to their bodies, excepting where very extraordinary force has been applied. In the arctic regions, where excessive cold might destroy them, a thick, wooly coat, or a covering very similar, protects the quadruped against the inclemency of the weather; and a dense, close mass of plumage, which in many assumes a thick downy form, secures the feathery tribe from a similar inconvenience. In tropical climates, where the influence of excessive heat is to be counteracted, the woolly coat of the former, is more frequently changed into a loose-hairy like covering, sufficient to ward off the sun's rays, but not so dense as to prevent that evaporation from the surface, so essential to carry off the superfluous heat from the body. While to the latter is given a light thin plumage, most frequently to be distinguished by those beautiful and variegated colours, which, decomposing the rays of *caloric* and light, serve to migitate the prevailing heat of the climate.

In fishes and reptiles, we find their skins well protected by thick and close scales in the one, and by a dense cuticle, or a shelly coat of mail in the other; while the insect and smaller tribes have their skins completely incased, or if externally *less* protected, their haunts are out of the reach of injury, or they find a ready retreat in proportion to the danger which assails them.

But *man* is brought into the world a naked and defenceless creature, totally incapable of supplying his most common wants; and for a considerable time after his birth, would perish from the inclemency of the weather, but for the protecting care of his own species; while he is afterwards, during frequently a long life, dependent upon his own exertions, or upon those of his species, for the supplies and gratifications which so bountifully have been conferred upon every other part of the animal kingdom.

To make up for *this natural deficiency*, his inventive powers are called into action; and by instruction and experience, he not only acquires the means of protecting his person against the inconveniences of his own climate, but also, by his ingenuity, he contrives to adapt his constitution to that of any other country, to which his curiosity or his necessities may lead him. This together with his being omnivorous, by which he finds a supply of food wherever he may be situated, renders him independent of circumstances, and gives him a place in opposite climates, where other animals, unaccustomed to the change, would degenerate, or perish in the attempt. But this is only one part of the benefit which man derives from being left to his own resources. For a knowledge of the means of contributing to *his* personal conveniencies qualifies him to supply the wants of others under similar circumstances, in return for such commodities as the productions of each country and the ingenuity of the inhabitants may furnish; and thus by barter, he lays the foundation of an extensive commerce; and as to enable him to effect this, the materials must be obtained, agriculture and the arts are called into his aid, opening to him a new field for action, which, in his earlier state of knowledge, he had scarcely contemplated.

The luxuriant foliage of Asiatic vegetation (for it was in Asia as we are informed that man was first brought into existence) would naturally suggest to him the use of leaves as the only means of protecting his skin against the inconveniences of the weather, until he had obtained the method of destroying such animals as he required for his use, or which might endanger his life by their attacks. Possessed of this knowledge, he would soon ascertain that their skins even *in an undressed state* would suit his purpose better than the flimsy covering of an assemblage of leaves; and advancing in acquirements, he would progressively discover the means of preparing those skins so as to render them subservient to ornamental as well as protective purposes. The mode of *converting vegetable substances* into similar uses, by which flax and cotton have since been so variously applied, and afterwards of availing himself of the labours of the silk worm, were of course of much later dates; but they all serve to show the progress of the human mind from its earliest efforts, to a period when a taste for luxury had increased its energies to a degree of which, comparatively, we could have hardly supposed it susceptible.

Thus our woollen, cotton, linen, and silk manufactures, with all their appropriate machinery, have each originated in the necessity in which man was placed to provide himself with clothing; and this he could not have effected, had not his attention been directed to the arts and to agriculture; though the attainment of other very important objects, have intermingled themselves with those pursuits.

The same observations which apply to the want of clothing, are also referable to the deficiency in the means of defence. All other animals have been provided from the natural structure of their frame, and from their habits with the intuitive means of defending themselves against their enemies. But had *man* trusted to his physical powers only, his race would soon have been extinct. For inferior in strength and swiftness to a large proportion, and in his structure, having no means of destroying the the more ferocious animals, he could neither have resisted, nor fled from their attacks; but must soon have fallen a prey to such of them, whose thirst of blood might render him an object of their conquest.

For this deficiency of *natural* defence, he is amply compensated, by his talent for stratagem, or by the force of his genius; thus affording proofs the most incontestible, of the superiority of intellect over physical force, however threatening its aspect, or well directed its energies.

His hands being the principal means by which his actions are produced, these would have been of no avail to him even with the co-operation of his feet, had he not by his own invention constructed instruments, which, *under his judicious direction*, few animals could resist; or brought under his controul some swifter animal, through whose fleet exertions he could fly from the attack.

The forest, in the first instance, would naturally suggest to him the source from which these instruments were to be derived; and hence the early use of clubs, and bows and arrows; but as he soon became acquainted with the working of metals, and iron being the most abundant, he would thence learn to manufacture out of that mineral the means by which he could still more effectually attack his opponents, or divide the flesh of such animals as he destroyed for his own subsistence; and this gave rise to the invention of spears, swords, and knives.

Thus from acquiring a knowledge of defending himself against his natural enemies, and of supplying himself with the animal food which his constitution required, he gradually learned also to attack and defend himself against those of his own species, to whom he might voluntarily or accidentally be opposed; which eventually led to the discovery of gunpowder, cannon, and fire arms, as well as to the erection of those forts and castles, through the agency of all which, so many important events have since occurred. And thus from the original helplessness of man, and from the inventions to which *that* has given rise, our most valuable manufactures, and our arts in general, have reached a perfection, to which, without those excitements, they could never have attained.

Having adverted to those circumstances in the creation which appear to have been intended to develope and call forth the intellectual faculties of man, we shall now take into consideration those particular attributes of his nature, physical, intellectual, moral, and religious, by which he is to be distinguished from every other part of the animal kingdom.

In his physical capacity, (the first for consideration,) we find man endued with faculties that belong to no other animal; and which affording a most comprehensive scope for the operation of his intellectual powers, bestow on him *of themselves*, a vast superiority over the rest of the creation.

These faculties are derived from the peculiarity of his external form and his attitude, which give him an almost unlimited command over his muscular actions; *his internal structure, and his organs of sense* not differing so materially from other animals, as to require a separate notice.

Had our time permitted, in addition to our account of the physical circumstances of man as above alluded to, we might have extended our observations to the muscles of his face, and to his features in general, by which his various feelings and passions are expressed, and through whose agency, so much of the human character may be understood; as well as to the increased quantity of his brain, in proportion to the size of his nerves, upon which so many important, distinct, and complicated actions depend. And we could have noticed in the brute animal, the marked flatness of the upper surface of the head, with a corresponding diminution of the cerebral hemispheres, and the much greater magnitude of the face in proportion to the other parts of the head, by which the latter is most satisfactorily to be distinguished from the human species.

But the subject is too comprehensive to embrace in one short view the whole of its interesting particulars; and I fear as it is, we shall have encroached too long on your patience in the detail of those parts of it which we have deemed to be of the greatest importance.

As it seems intended, that the subordinate animals should move in a limited sphere, and that their enjoyments should be confined to their physical necessities; it is has been ordained, that their vision be chiefly directed to the objects before them, which requiring little elevation for attainment, an erect posture was not necessary for the part which they had to act.

But man, to whom the whole universe was to be open to his observation, required an upright attitude that he might survey the surrounding objects above and below him, as suited his fancy, or as the circumstances of his case should require. It is this commanding attitude which endues him with so much influence over the other parts of the creation; and from its novelty, and from the extensive action it admits, strikes terror among, or commands the affection of other animals, many of whom, were they conscious of their own physical power and degradation, would never submit to his controul. From this important attitude also, he is enabled to investigate the different parts of the universe, celestial, and terrestial, and assisted by his intellect, to ascertain the principles by which they are regulated, and the effects likely to be produced; and from the same source, he can perform actions, and from those actions produce consequences, which no other animal can accomplish; Providence, therefore, has not left this property in man open to chance, or to human contrivance; but from the arch-like form of the human spine, from the great width of the pelvis and through that the extension outward of the thigh bones, from the increased bulk of the muscles of the lower extremities, and from the form and complete flatness of the foot, it has made it an invariable law from which it is not in man's power to deviate, that his position should be erect; and he consequently is by nature a biped animal only, distinct in his attitude and actions from every other part of the creation. For though the flexibility of his body admit of his moving upon his hands and feet for a short time like the quadruped, yet from the shortness of his arms in proportion to his lower extremities, in which by far the greatest muscular power is vested, he soon finds it necessary to restore the equilibrium of his body, by returning to the erect position, through which alone, his natural movements can be performed.

We see this proneness to assume the vertical position, even in the infant age of man; when we may observe those children, in whom an increase of muscular power and of bony firmness have prepared them for the attempt, constantly exerting themselves to acquire the erect attitude; and if left to themselves, as they ought to be, they progressively, though effectually, accomplish their object, without the risk of producing those distortions and consequent bad health, too often the consequence of a premature attempt to effect the same attainment by artificial means.

The awkward sitting posture, assumed by the ape families, and natural to the kangaroo tribes, which have been adduced as instances in which the brute animal can acquire the vertical position, admits of no comparison with the bold, firm, and erect attitude of man; nor do it confer upon them the same power of action, which belongs to the human species. In the ape families, it is principally the result of education and example; and being unnatural, cannot be long continued without a frequent reference to the horizontal position. In the kangaroo, it admits of no other motion but that of bounding or leaping forward; and the posture being a sitting one, the foot, so important to the human attitude, has no share in its production.

But independently of his erect position, in what animal do we observe such a variety of movements to which his external structure in general contributes, as in man? So much flexibility of body, such an extension and contraction of his limbs, and so dignified a deportment in his whole frame, when circumstances call forth the feeling to produce it? In the acquirements of dancing and of fencing, in wrestling and in tumbling, in his pugilistic attitudes, and in the evolutions he can perform while under military exercise—all these diversities of actions and of attitudes, are most amply illustrated; and though several may be of little importance in themselves, yet, from the capabilities of action they afford, they confer great advantages in particular situations, where his safety or the attainment of his object may depend upon bodily exertions, or upon the diversity of his attitudes and actions.

In the movement of his extremities, man has resources such as no animal in nature can imitate. By one motion of his lower extremities, assisted by his body, he can instantly face an object or turn his back to it, meet it on one side or the other, or alter his direction in any way he pleases, within the space of one or two seconds. He can walk longer *upon the average* than any other animal; and even in running, contend the palm of victory with most of them, for a few paces; while in muscular strength, he can raise, draw, and support much greater weights than any animal of the same size with himself.

But if the body and extremities *generally* admit of such diversified movements, what may not be expected *separately* from those best instruments of the mind, *the human hands*, whose structure and situation mark them out for so many useful applications?

Other animals from their horizontal attitude, and from the limitation of their wants, can dispense with the use of hands, since a supply of food being their principal necessity, and this being usually within reach of their mouths, they can always obtain it by the agency of their teeth, assisted in some animals by their claws. But *man*, from his erect attitude, cannot procure his food in the same way; and from the mixed nature of his diet and the culinary process and minuter division it has to undergo before it be suitable to his digestion, he would perish had he not his hands to prepare, divide, and convey it into his mouth, as his necessities require; and this circumstance alone confers on him a physical attribute distinct from all other animals.

But it is not his common natural wants only, which the hands of men were intended to supply; but a comprehensive variety of artificial ones, which the progress of society and of human improvements, have rendered necessary to his happiness, and from long established habits, even to his very existence. When we consider all those actions in which the hands alone are concerned, as connected with our agriculture, our architecture, our navigation, and our arts in all their applications, domestic, and general; embracing those numerous articles of luxury which long established habits have rendered almost indispensible, and the various instruments of offence and defence; the bold execution and vast magnitude of some, and the extreme minuteness and ingenious adjustment of others; we may readily anticipate how helpless man would have been without these important agents, and how trifling and how insignificant are the manual qualifications of the quadrumanous animals, even when the structure of their hands would appear to imply much greater capabilities than we find them actually to possess. The hands, therefore, present one of the most striking physical attributes by which man is to be distinguished from the rest of the animal kingdom.

We should now have proceeded to the intellectual attributes of the human species, had not a subject presented itself, which, from its partaking equally of an intellectual and organic character, has rendered it difficult to be determined under what head it shall be placed. We allude to the *attribute of speech*, one of the noblest qualities bestowed on man.

Experience has taught us, that this very comprehensive power, depends upon the co-operation of the voice and tongue, called into action by the dictate of the will; and that, as applied by man, it is a property possessed by no other animal. But we cannot so easily explain, from the structure of the parts, (that is, in a physical sense) why man should be so endowed; since admitting all the perfection bestowed on human mechanism, yet we do not see *that* great difference in this instance which should prevent the brute species (some of them at least) from expressing their ideas by language, with as much facility as man. We must, therefore, look to some other source to explain this phenomenon; and we shall find it depends upon example in the first instance, leading to mechanical imitation; and next, upon intellectual comparison and association of words with things, assisted by education and subsequent experience.

All animals, more especially of the class to which man belongs, possess the means through monotonous tones, of expressing their ordinary feelings, and apparently of conveying them to those of their own species, so as to be understood; and in the bird class, we see instances, where, by instruction, distinct words, and even many sentences can be articulated, so as to be mistaken for human utterance. But we have no instance, so far as our judgment can decide, but in man, where a mutual communication *of varied and separate ideas* can be effected through the medium of language. To him therefore this blessed attribute exclusively belongs, and which in itself points out the line of distinction between man and all other animals. Had it been denied to him, of what avail would have been those other noble qualities which have been so benevolently implanted in his nature? They would only have rendered him more sensible of the forlornness of his situation, by depriving him of that mutual communication of ideas from which alone the best friendships of his nature are derived; by which the confidence between man and man is preserved, and his wants reciprocally expressed, and supplied; the mind is expanded in every direction that can call forth its energies, or enlarge its powers; and through whose agency, the bonds of society are kept in that due tone, by which alone the moral principle can preserve its influence, amidst the opposing conflict of human passions.

But if man has derived so much consequence from the attributes we have already detailed, how much higher does he rank, and with what increased dignity does he not appear, when *the faculties of his mind* in all their comprehensiveness, are contemplated; when his moral qualities are found to give tone to the actions, which his intellect suggest; and when his mental and moral attributes combine (independently of a religious feeling natural to man) to produce those elevated sentiments, which losing sight of all worldly considerations, teach him to acknowledge a superior, protecting power, to whom he owes obedience and veneration, and to perform the duties which such an acknowledgement necessarily inculcates.

These combined circumstances mark out man to be distinct from all other animals. For though we may allow a *limited* portion of intellect to the brute species, in which, independently of *instinctive impulse*, some reflection, much sagacity, and in many instances, (in so far as the physical necessities of the animal are concerned) great ingenuity are to observed; yet the total absence of all moral and religious feeling in such animals, at once remove from them every approach to equality with man, even had their physical structure *without one deviation* corresponded with that of human frame.

The brute species we know require only growth to call into action all their respective attributes, of which very many of them, are in full possession, from the moment they are first brought into existence. No education therefore is necessary; food and common protection when required, are all that is wanting, to answer *their* limited ends.

Man, on the contrary, is born under circumstances directly opposite. For his entrance into life, is not only marked by the most utter helplessness, and a total insensibility to all external agents; but he is obliged to pass through a long intellectual minority, and to be subject to unremitting, and rigid moral discipline, before he be fully prepared to act for himself.

We accordingly find, that contrary to other animals in which the organs of sense are very early developed, his birth is distinguished by no other phenomenon, than the ordinary appearances of vitality. He can neither hear, see, nor know where to find his food, and only very partially (if at all) feel the application of external substances; the crying, upon the admission of air into his lungs, being only an instinctive action to promote their expansion; while before any of the above faculties are discovered, a variety of other animals have reached their fullest degree of perfection.

As he advances in growth and strength, vision begins to open to him the surrounding objects, and light and colours attract his attention, but without any consciousness of their distinction, or of the cause of the amusement they afford him. His taste, before indifferent to the flavour of any substance, now begins to teach him to reject the nauseous and to prefer the palatable; and his sense of hearing, at first deaf to every noise, awakens his attention to sounds, the louder the more attractive; while he soon becomes feelingly alive to the painful sensations which mechanical applications, or internal causes, may produce.

Thus his perceptive faculties being progressively developed, he is gradually prepared for a more enlarged observation, and for a new train of feelings; and he soon learns to display a preference for, or a dislike to those things, sounds, and sights, which at first had only in a general degree, excited his curiosity.

As he advances, a taste for imitation discovers itself; and he not only endeavours to take off those by whom he is surrounded, but learns from them a few of the words, which he so often has heard repeated; but at first, more from their sound, than from a knowledge of their meaning; and it is only by very slow degrees that he at last comprehends their signification. It is about this period, that those selfish passions begin to bud, which, naturally engrafted on the constitution, are so often in future life, (if not early corrected,) productive of the most mischievous consequences; and as good is most frequently intermixed with evil, it is now we observe, *in embryo only*, those finer affections and kindly feelings, which afterwards are connected with the noblest sentiments and best propensities of his nature.

As the strength advances, the common use of the limbs becomes fully established, the speech is perfect, and a few of the symbols of language are comprehended; while curiosity is still further awakened, and a desire to *see things*, ends in a request to know their structure and use. The memory now improves, and a knowledge of right and wrong, with the fear of punishment, and the love of reward, altogether prepare the mind for a more active dicipline, and an enlarged instruction.

In a few years, full boyhood commences; the physical powers have acquired sufficient stability to admit of very active bodily exercise; the moral duties (however occasionally opposed by perverseness,) are better understood; the mind receives with readiness and retains many of those multiplied ideas, which are afterwards to be practically applied; and a desire for knowledge (though limited in its objects,) bespeak the progress of the understanding, and the mental excitements which early practice had produced. This stage of coercion and instruction is gradually preparing the mind for nobler attributes, and for much greater achievements.

The years advance at last into early manhood, when the passions take a new direction, and produce a train of actions very different from those of more youthful days; and though the mind, at this period, be too little under the controul of the judgment, yet its comprehensive faculties, and the energy by which they are directed, at once evince the increase of its powers, the result of an improved constitution and previously mental exercise.

The passions at this period are strong, and impatient of controul, giving a tone to propensities, which, in some, lead to the most disastrous consequences, in others, to highly beneficial results—to noble and disinterested actions, or to gratifications the most base and selfish—to bold and successful enterprise, or to speculations which carry upon the very face of them nothing but ruin and desolation—to dignified friendships and attachments, or to connections that entail disgrace and misery upon the parties for the remainder of their lives.

In his intellectual capacity, now fitted for any undertaking, emulation urges on the youthful man to excel in those arts and sciences, and in those professions, in which fame is to be derived or rank to be obtained, emolument to be procured, or his own immediate gratifications to be indulged; and the world being open to him, he boldly enters into its concerns, too often regardless of its consequences, and regulates his pursuits according to the object in view, however difficult that object may be, or dangerous in the attainment; and it is only when his judgment begins to operate, that he discovers the necessity of conforming to the circumstances of his situation. Thus at this early age, we see great capabilities, with a weak application of the reasoning powers; bold conceptions and great inventive resources, but a deficient judgment to conduct those qualifications to an useful end.

In his moral and religious duties, (though well instructed,) his passions too often throw a shade over his better propensities, and suspend their operation until a more matured judgment and increased experience convince him of his error. When that period arrives, he has reached the *perfected state* of manhood in all its attributes and comprehensiveness; when long previous mental exercise and diversified human actions, combine with constitutional strength, to impart that tone to his character, from which his best and most useful efforts are to be derived.

His passions and propensities now, unless some predominant impulse interpose, are rendered subservient to those plans upon which his future success in life is made to depend; and these urge him on with a firmness and consistency, in which in his earlier life, he was by no means susceptible.

Nothing now appears too difficult to attempt, no phenomenon too deep for investigation; and his skill and ingenuity being called on to plan, and his reasoning upon causes and effects to decide upon a measure; he vigorously pursues whatever he determines upon, until it be fully accomplished.

As proofs of the versatility of his talents, we need only advert to the very opposite pursuits to which *he now* can direct his attention.

If agriculture be the object, with what assiduity does he acquaint himself with the quality of the different soils, with the improvement of which they are susceptible, and with the materials and labour by which that improvement is to be effected! How judiciously he selects the suitable seeds, and by *measured step*, commits them to the earth, so as, in due season, to vegetate in equal proportions throughout the whole of the space to which they have been applied! How many implements has he invented, and animals domesticated, to facilitate and give effect to this most useful of occupations; and what attention has he not paid, and labour bestowed, to turn to profitable account the several branches of which it is composed!

Should his attention be directed to the arts, his physical and intellectual capacities are still more comprehensively called into action. For great strength and labour are required to manufacture the more bulky articles, much nicety and discrimination in the construction of those which are complicated; while his best resources are exerted to find out and prepare new materials, to keep pace with the improvements, which increased knowledge is constantly effecting.

Thus not satisfied with the various productions *of the surface* or the earth, he must examine its internal contents also, by penetrating into its depths, and bringing up to his use, a variety of substances, of which no application can be made until they have undergone his further investigation, and submitted to those processes necessary to render them susceptible of useful purposes. But still even these are not sufficient to supply all the wants, which his active mind is constantly creating; or to keep pace with the numerous inventions, to which the fertile ingenuity and emulation of his competitors give rise. Foreign countries must be explored to find out new articles, by which his varying arts are to be perfected and increased; and the contrivances of other nations are to be consulted, to ascertain how far they will admit of such modifications or improvements, as may afford a greater scope for his own inventive faculties.

In possession of all these various means, what vast and comprehensive results have not been the consequence?

Noble and magnificent edifices, upon very many of which, the long hand of time has made no impression, bespeak the grandeur of his designs, and the industry and labour bestowed on their execution. Stately vessels, complete in all their parts, and equipped with every requisite, traverse the ocean in all directions; and by the exactness and security with which they perform voyages the most distant and dangerous, evince the ingenuity displayed in their construction, and the accuracy and the nicety with which the effects to be produced, have been calculated.

In a still higher degree are the inventive faculties illustrated, in the mechanism of those finer pieces of workmanship, in which the greatest skill is required for the formation of their several parts, and the nicest adjustment in their application, to qualify them to answer the intended purpose, of which the improved chronometer is a splendid example; and if to these, we add the other various discoveries and inventions that from time to time have been made, and the useful applications to which *they have* been adapted—the first formation of letters, by which the art of writing was produced—the manufacture of gunpowder, cannon, and small fire arms, with the science and art of war, as at present practised—the discovery of the mariner's compass, and the improvements in navigation in all its branches—the art of printing—the invention of clocks and watches, of the barometer, thermometer, and of magnifying glasses, by which defective vision is obviated, and (as in the microscope) the minuter objects of nature can be demonstrated—the discovery of the circulation of the blood, of the laws of gravitation, and the causes of the tides—the establishment of the Copernican or solar system, and the improvements which astronomy has derived from the invention of telescopes—the mechanism of mill and other machinery—the expansive and impelling power of steam, with all its diversified applications—the lighting of our houses and streets with hydrogen gas—and a long list of other inventions and contrivances to which the above discoveries have given rise; we are presented with such a phalanx of diversified talents and of mental resources, as must for ever dissolve the chain that would link together man with the other portions of the animal kingdom, and deny the propriety of associating any of the brute tribes, in the same order with the human species.

From the application of the arts, *man* is necessarily led to the pursuits of commerce, in which he never fails to render subservient the inventive faculties of others, to the boldness of his own comprehensive speculations; and while a rigid integrity, the chief prop of his credit, and great personal generosity are displayed, (we speak of the British merchant,) a deep prospect of gain intermixes with all his actions, and combined with a systematic knowledge of business, and a wordly acquaintance with mankind, stamp upon him a character peculiarly his own. Through his instrumentality, the ocean is traversed in all directions by vessels conveying to their destined ports the productions of every part of the globe, and opening communications between countries as remotely situated, as opposed to each other in physical constitution, habits, and language. And *from his* comprehensive transactions, our navigation and our manufactures derive their chief impulse, and our necessities and luxuries are furnished to us upon a scale, which, without his exertions, would be very limited indeed.

If the profession of arms be his object, how readily does he acquire the military character, the attitude erect, the bold and commanding step not to be mistaken! And with what application does he direct his attention to the study of the science in all its branches and ramifications, the the various modes of attack and defence, of advance and retreat, of lying in ambush to surprise, and in forming well concerted plans to deceive his enemy, in providing for all the contingencies of a campaign, or in guarding against the consequences which too often succeed its close! In the practical part, to what discipline does he submit, and with what geometrical precision does he perform those various evolutions and movements, which modern warfare has rendered necessary to success! How reconciled to fatigue and privations on the march against the enemy; how steadily bold and daring in the field of action, and with what reluctance does he quit it, when the chances of war have denied him the hope of victory!

In his naval capacity again, we find man assuming altogether a new character, and acquiring a knowledge totally opposed to every circumstance, which his former experience had opened to his view. Thus, from the effect of association, he attains a rough exterior, and a dry vein of humour, combined with a kind heart, a generous disposition, and a thoughtless indifference to what others consider of importance, or to that which immediately regards his own personal advantage. With these attributes, and a romantic love of change, he pursues his occupation; and in the midst of dangers, to others the most appalling, he performs a most hazardous duty, unruffled by the threats of the elements, or by the rocks and shoals by which he is so often surrounded. In the management of his vessel, (for we speak of the profession generally) what skill does he display, so that by the conjoint operation of the rudder and sail, she can resist the *undue* influence of the wind, and pursue her course, as near to it as human art can place her! With what nicety does he not make his astronomical observations correspond with his calculation of distances and time, so that by a knowledge of the latitudes and longitudes of places, she shall reach her destined port with an accuracy truly wonderful! And in the hour of battle, where do we see more skill displayed in the mode of attack, or more steady courage evinced, or greater exertion bestowed, when directly in contact with the enemy?

In pursuit of the learned professions, we observe the progress of the human intellect still more exquisitely marked; for in these, the mind losing sight of ordinary considerations, acquires new dignity, and an enlarged scope of action.

Deep study and intense application to the subject, the acquirement of ancient and modern knowledge, a familiarity with the physical and moral constitution of man, and a minute investigation of those principles which are to form the basis of future practice, all mark the intellectual labour bestowed on those very important pursuits; and which, gradually furnishing the mind with useful knowledge, and the most comprehensive resources, are productive of talents the most brilliant, and in their practical effects, the most beneficial, of any perhaps to which the human mind can be directed.

But it is in metaphysical disquisitions, and in scientific research, where all the reasoning powers are called into their fullest activity, that the human intellect appears to have reached its highest degree of perfection.

Thus the whole scope of nature being open to man's view, he investigates her various works with a scrutinizing eye, the situation and structure of each portion, the relative action upon each other, the probable causes by which these effects are produced, and the practical uses to which each minuter part can be applied.

To promote his researches, he calls into his aid various systems or sciences of his own invention indeed, but which, being founded upon the immutable laws of nature, evince the comprehensiveness of his designs, and the genius by which they are directed.

Among the most important of these may be mentioned mathematics; which teach him to calculate numbers, quantities, magnitudes, and distances, with an accuracy never to be questioned, and irresistibly impress on his mind, that in all investigations, the emanation of truth is to be his primary object, and that this can only be accomplished by a judicious arrangement of his ideas, the closest application to the subject, and a just comparison of things as they present themselves to his notice.

Thus by a knowledge of this interesting science, numerical questions have been answered, problems solved, and calculations made, that without it, never could have been accomplished. While not only the dimensions of the globe and of its several parts have been accurately ascertained; but (as we have before hinted,) the laws of space, magnitude, and quantity, as well separately as relatively, have been laid down with a precision, that, independently of their practical importance, bespeak an advance of intellect, and a degree of industry, most truly astonishing.

With mathematics as a basis, man is also prepared to enter upon these sciences, which practically explain the laws by which each proportion of the universe is regulated; and thus to descend to the minutiæ of things, which, before, he had only viewed in the outline.

Thus by the science of astronomy, he is enabled with wonderful accuracy, to determine the situation, and comparative magnitude, and distances of the planetary bodies, their motions round their grand centre of attraction, the sun, and in the circles of their own orbits; and to predict with unfailing nicety, and certainty, the period and duration of the eclipses, to which, in the variation of their relative positions, they are occasionally liable; to remove the superstitious apprehensions entertained in former times, upon the sudden appearance of comets, by demonstrating their tracks among the other heavenly bodies, in their approach to, and recession from, the sun, while performing their own revolutions; and that, like the planets, they are opake bodies, deriving their lustre from that great luminary; to explain the phases, or changes of the moon, the causes of the alternation of nights and days, and of the variations of the seasons; the doctrine of the tides, and the laws of gravitation; to lay down with accuracy, the latitude, and longitude of each place throughout the globe; and to make those improvements in navigation, which early mankind could never have deemed practicable.

By the science of geology, the structure of the crust of the globe, its different strata, its volcanoes, and other phenomena have been explained; and the great deluge to which the earth had formerly been exposed, satisfactorily accounted for.

By hydrology, the doctrine of the ocean

and of water in general, and by pneumatics and meteorology, the properties of the atmosphere, its extraneous particles as derived from the electric fluid, caloric, humidity, and terrestrial exhalations, have been clearly illustrated.

By natural history generally, the external distinction and character of animals, vegetables, and minerals, have been brought to his comprehension; and by chemistry, the next in importance to mathematics, the constituent parts of matter, their relative action upon each other, and the phenomena which those actions produce, have been rendered familiar to the most common understanding.

From the science of mechanics, man has learnt the principles by which the moving powers are regulated, so as to give an impulse to, or render quiescent, inanimate bodies, by the agency of which, our various machinery, and most of our mechanical contrivances are governed; and out of this most useful science have emanated, a variety of inventions most important to the arts, and to society in general.

But the human mind is not satisfied with investigating the laws of natural bodies only, but it must inquire into its own resources also, its leading phenomena, and how far its spiritual is connected with its material portion; and this inquiry has gradually led to the contemplation of the supreme Being himself, his various attributes, his probable nature, how far and to what extent he influences the moral world, and by a comparison of *man's real condition*, with *his possible one*, what degree we shall bear to him in that future state to which we are all looking forward. But here the understanding receives a check, that from its far advanced, and still advancing state, the mind might not be quite so prepared to anticipate.

It is true, in the structure of the universe we see a wonderful piece of machinery, composed of a variety of parts, each by different means working its own useful ends, but yet contributing to the general harmony of the whole. We observe also in the natural world at least, that no effects *can be* produced without some primary cause, and we consequently *and most justly conclude*, that this beautiful contrivance must have some superior agent to give an impulse to its various movements. But as the source of all these effects has never been seen, or communicated with by us, we can neither decide upon its form, its situation in the universe, nor in what manner it acts. We only know from the results its power far exceeds our own; that we ourselves are but a small and subordinate part of a system regulated entirely by its superior agency; and that as we command obedience from those parts of the creation placed under our controul, so is submission due from us *to that higher authority*, at whose disposal all sublunary things appear to be subservient.

Thus disappointed in the pursuit of a knowledge which the divine hand (no doubt for the wisest of purposes) has withheld from his comprehension, man *has more rationally* directed his attention to the science of the human mind, as derived from experience; and investigating the powers of the understanding with the moral results, the tendency and influence of the passions, and the controul over them which religion has established ; he has displayed that erudition and research, and that knowledge of the human mind in all its intricacies, that at once stamp upon his character intellectual attributes of the highest order, and such as the most fastidious sceptic can never impugn. In confirmation of this, the writings of our own distinguished countrymen, independently of those of other nations, afford the most illustrious examples.

Having endeavoured to trace the progress of the human intellect from its earliest dawn to the highest degree of perfection to which it appears to have reached, and to shew that the latter is *rarely* attained, but by education and long experience; it would be imposing on the understandings of this enlightened assembly, to deem it necessary to draw a comparative distinction between the intellectual attributes of man and the brute species, or to suppose for one moment that they are only shades or approximations of one and the same system. I shall, therefore, without further comment, proceed to the moral and religious qualities of our species, with which we propose to conclude our lecture.

I had occasion to notice in the early part of my discourse, that for very wise purposes, all animals, excepting man, were born with the attributes adapted to their particular nature; and which, consisting merely of those common actions essential to their vital existence, required only physical strength and growth to call them into their fullest activity. That man, on the contrary, brought nothing into the world but capabilities; and that these, if not exercised by the instruction of others, and by his own industry, the purposes of his creation would have been altogether nugatory. Thus from his birth and for a very considerable period afterwards, being made to depend upon the assistance of those by whom he was brought into life, this could not have been effectually afforded him, without submission on his part; and thus man from his cradle may be considered as commencing that course of morality, which, improving as he advances, was to influence every action of his future life. Obedience, therefore, and the controul of his passions, were the first rules he was taught; and out of these were to emanate the love, respect, and gratitude due to those protecting benefactors, through whose kindness all the blessings he enjoyed were to be derived; and afterwards good-will and integrity towards others, from whom *minor* benefits might be received, or who formed a part of the society in which he was placed.

As the reasoning faculties improved, his own feelings, independently of religious instruction so well calculated to strengthen them, would combine with the dignified pride of his nature to suggest to him the propriety of enlarging upon those duties which had been inculcated in early life; until becoming a habit, formed when the most lasting impressions are received, he gradually acquired all those moral propensities, which properly directed, are the brightest gems which adorn his character.

Thus in what animal, but in man, do we see the parental affections continued, after the necessity of them has ceased; or where is to be found the love of collateral relations, or the disinterested friendships of earlier intercourse, often only to be dissolved by death, but in the human species! See with what rigid integrity, in all the relations of life, does man frequently regulate his conduct, not to be shaken under temptations the most seductive, or motives the most urgent and plausible; and how tenacious is he, even at the risk of his life, of his moral rectitude, when unjustly impeached, or even for one moment suspected! What a distinctive part of his character are those kindly feelings, which, dictated by humanity, call forth a protecting consideration, not only for his own species, but also for the animal kingdom in general; or which induce him to make great personal sacrifices, and even to incur bodily risk, to save an individual to whom he is otherwise indifferent, or even a poor animal from destruction! With what assiduity does he not attend, and how many acts of kindness bestow, upon his friend or neighbour on the bed of sickness, or when mental affection stands in need of his assistance and consolation? With what submission and respect does he not bend to those laws, though often interfering with his best interests, which the welfare of society has rendered necessary; and what a tone has his moral education given to his manners and social habits, producing urbanity and dignified courtesy in the one instance, and hospitality and good-will to his neighbour in the other!

These are but few of the moral attributes which belong exclusively to man, and which bring him as near to the Divinity, as, in our humble state and ignorance, we dare to place him. And though they be the result of education and experience, acting upon the susceptibilities of his nature, and increased no doubt and rendered permanent by the reflection peculiar to the mind of man; yet they do not the less indicate that divine influence, from which the best of human actions derive their tone; and without whose agency, morality would be as fluctuating and as variable as the passions, which the practice of it, is calculated to controul.

We are now arrived at the last subject for consideration—the religious attributes of man; in the treatment of which, it would not become us in this place to comment upon any particular faith or doctrine; the line chalked out for us being merely an illustration how far *generally* a religious feeling predominates in the human mind.

The physical capacities of man we have had occasion to notice, depend upon the structure of his frame and upon accidental circumstances, which call forth those energies of which, *from constitutional causes*, he is naturally susceptible.

His moral qualities arise from education and worldly experience, strengthened and confirmed by religion, but not originating in that source; and his intellectual ones, partly from instruction, but principally from the necessities and circumstances under which he is individually placed.

His religious attributes are exclusively of native origin, which independently of all contingencies, have been implanted in the mind of man to be his monitor and guide, under all the temptations to which, from his physical propensities, he is naturally exposed; and only requiring the exercise of his mental faculties, to call them into full effect, and activity. And though we must allow, that education and example give a bias to the faith we profess, and to the mode of worship we prefer; and that as reason advances, our views of the subject expand in proportion, and the attributes of the Deity become better understood; yet the absence of all these circumstances, would not, for one moment, remove from the mind, that innate and conscientious sense of right and wrong, which blends itself with all its actions, and calls forth a dread of consequences *from some superior power to our own*, when our feelings dictate to us, that those actions are at variance with what we know to be right.

In confirmation, we may safely aver, that in no part of the world to which man has had access, however obscure the subject may appear in some few countries, where, from our ignorance of the people and language, the real sentiments of the natives have been but faintly understood, has a religious feeling been wanting; and whether that feeling be displayed in animal, or in human sacrifices—in the worship of stones or of other natural substances—of the sun or of any the planetary bodies—in bowing to idols—or in humbling ourselves *before the great Unknown*, by whom all things are regulated—it is equally in each, and in all, an acknowledgement of a superior power, whose influence is felt, and feared—of a sense of right, and wrong—and of a dread of punishment, when our consiences tell us, that wrong has been permitted to prevail, over the dicates of right.

FINIS.

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LECTURE VII.

ON THE MAMMIFEROUS ANIMALS.

Having revised and considerably enlarged upon the Lecture, which, upon a former occasion, I had the honour of delivering to you on the animals referred to in the class *Mammalia*; and having, in my present paper, on the same subject, introduced the history of animals not before described; it will afford me much satisfaction, should the observations now to be submitted, be the means of inviting your attention to this branch of zoology. For though man indubitably holds the most predominant rank in the creation, and therefore his history has previously been treated; yet, the mammiferous animals approach so near to him in their structure, and in many of their qualities, are so often interwoven with his wants and his occupations, and generally take so conspicuous a part in nature, that they irresistably awaken in us a desire to become better acquainted with their laws, with the probable purposes of their creation, and in what manner and degree they are inimical, or can prove beneficial to our own species.

Under this impression, I have been induced to communicate the following remarks; and as the varying classifications of the present day have not been consolidated into one system, however we may admit the improvements suggested by Blumenbach, Cuvier, and other modern naturalists, I shall, for the sake of conveniency, follow that of Linnæus; and having gone through his several orders, I shall conclude with such general observations, as a contemplation of the whole will naturally suggest. But, as the subject is too comprehensive to admit of a description of every animal, I propose to mention, in general terms only, the several species which belong to each order; and to enlarge more particularly upon a few of those animals, whose history is likely to prove the most interesting; commencing with the mammiferous quadrupeds, and ending with the whale tribes.

By mammiferous quadrupeds, we mean all those animals, (whales exepted,) which, with a complete skeleton, are to be distinguished by having a perfect brain and nervous system; a double circulation, performed by a heart with two auricles and two ventricles, possess warm, red blood, and whose females produce living animals like themselves, which they uniformly suckle. Such animals have their bodies more usually covered with hair; they belong to the earth, and live upon its productions; (though some also resort to the water in search of food,) and they approach the nearest to the human species, in structure, habits, and intelligence. From their mode of feeding their offspring, they have been classed by naturalists, under the head of *Mammalia*; to which, from a similar cause, and from a strong resemblance in their internal structure, the whale tribes have also been attached; but as the latter animals differ from the former in their external conformation, in their mode of action, and in the element in which they live which equally entitle them to be ranked with fishes, they will be brought under a separate consideration.

Linnæus has divided the mammiferous quadrupeds into six orders, the character of which is taken from the number, structure, and situation of the teeth; each order into genera, from a still greater variety in the above particular, or, in the formation of some other external part; each genus into species, from a difference in the general outline, and in the particular habits of the animal; and each species into varieties, from some slighter shades of distinction.

In the first order, which, from including the human species, has been denominated *Primates*; the animals, excepting some species of bats, with a varying number of grinders, have parallel front teeth, or grinders in each jaw, and one canine tooth on each side of the incisors. In this order, the feet resemble hands, having fingers for the most part furnished with flattened oval nails; and the animals belonging to it, live partly on animal, and partly on vegetable food. It consists of four genera; including man, the ape tribes, the lemur, and the bat families.

Having, in the preceding lecture, treated upon the natural history of man, the animals belonging to the ape genus become the next for consideration. Of these four species, between sixty and seventy varieties have been noticed by naturalists; and, as they all, more or less, in their structure and actions, bear some resemblance to the human species, they have naturally excited the attention of the philosopher; but more especially the Ourang Outang, of whose history therefore, I propose, after a few general observations on this genus, to submit to you a brief account.

The physical distinctions of the ape genus are to be found, first, in the structure and situation of their teeth, they having four incisors or cutting teeth standing alone in each jaw; molares or grinders with obtuse points; and between the latter and the incisors, canine teeth, solitary and projecting.—Secondly, in possessing four hands in the place of feet, which gives them that facility in climbing, which forms one of their most distinguished attributes.—And lastly, in the resemblance of the uvula, ears, eyelashes, hands, and internal structure, to the human species. The genus admits of a subdivision into four separate species, the distinction of which is to be found in the tail.—Those without a tail, retaining the familiar term of *Ape;* those with a short tail, that of *Baboon;* those with a longer tail, that of *Monkey;* and those with a prehensive tail, or a tail serving as an extra limb, that of *Sapajou.* The three first species are to be met with in the warmer latitudes of Europe, Asia, and Africa; the last in America only. Those in Europe, which are apes without tails, are confined to the rocks of Gibraltar, upon which I have had frequent opportunities of seeing them; the females, with two or three young ones on their backs, leaping with wonderful agility from rock to rock, without, in the least degree, disturbing those they were carrying. They live upon the wild fruits and herbage that grow on the rock, and when I saw them, they were extremely wild and difficult of approach, a few appearing of an unusually large size. Of these a specimen was afforded during my residence in the garrison, when an ape of more than ordinary dimensions was knocked down and captured alive, by the soldiers; but either owing to improper diet, or to bad treatment, he only survived a fortnight. The common size of the Gibraltar ape is about that of a small terrier; the one captured, was as large as a Newfoundland dog. He was extremely wild and untractable, and bore every mark of very advanced old age; his body being quite emaciated, nearly the whole of his teeth gone, and the hair of his head had become scanty and quite grey. Why these animals should thus be confined to one spot in Europe, naturalists have never been able to decide; though, from their prevalence upon Mount Abdyla, on the opposite coast of Africa, (familiarly known by the name of *Ape's Hill,*) it has been conjectured that they were either brought over from thence by the Moors, at the time of their invading Europe, and afterwards become naturalized to the rock; or, that the two mountains, denominated by the ancients, the *Pillars of Hercules,* must, at some former period, have been united.

The Ourang Outang,, now to be described, from having no tail, and from other resemblances, may be considered a variety of the ape species. But its history, from defective information, more particularly of the animal in the adult state, is involved in so much uncertainty, that even at the present day, it is extremely doubtful, whether it has been properly identified as a distinct species, or whether it ought only to be considered a variety of the common ape. This is partly to be attributed to the systematic writer being obliged to take for granted, what others have written before him, or to obtain his information from the unscientific traveller, who, from the love of the marvellous, or from allowing his imagination to get the better of his judgment, has often given very extraordinary accounts of the animals he has seen in their wild and native state, and which, subsequent experience has not confirmed; and partly to those animals which have been actually brought under the eye of the man of science, being too young to determine what their real form and character would have been, had they reached the adult state.

Thus Linnæus, whose definitions in general are so clear and distinct, was led, not only to believe the most exaggerated accounts of the Ourang Outang, but almost to allow him one of the most important physical qualifications of man, that of speech. And Buffon, with other extraordinary attributes, had led himself to believe, that the erect position when he walks, is his natural attitude; while he has confounded the Ourang Outang, a native of Asia, and apparently a mild and docile animal, with the Chimpansee, Pongo, or large African ape, whose ferocity of character, and ungovernable passions, are stated to render travelling dangerous, in the countries which he inhabits.

We will give Buffon's own account of the animal which he witnessed, as it will serve to shew that the actions he relates were obviously artificial, the result of previous education, and that they took place under the coercion of the keeper. After concluding, that until better informed, we must regard the large African and Asiatic apes, as constituting but one species, he proceeds:—"The Ourang Outang, which I saw, *walked always on two feet, even when carrying things of considerable weight.* His air was melancholy, his gait grave, his movements measured, and very different from those of other apes. He had neither the impatience of the Barbary ape, the maliciousness of the baboon, nor the extravagance of the monkey. It may be alledged that he had the benefit of instruction; but the other apes, which I compared with him, were educated in the same manner. Signs alone were sufficient to make our Ourang Outang act; but the baboon required a cudgel, and the other apes a whip, for none of them would obey without blows. I have seen this animal present his hand to conduct the people who came to see him, and walk as gravely along with them as if he formed a part of the company. I have seen him sit down at table, unfold his towel, wipe his lips, use a spoon or fork to carry the victuals to his mouth, pour his liquor into a glass, and make it touch that of the person who drank along with him. When invited to take tea, he brought a cup and saucer, placed them on the table, put in sugar, and allowed it to cool before he drank it. All these actions he performed without any other instigation than the signs, or verbal orders of his master; and often of his own accord. He did no injury to any person; he even approached company with circumspection, and presented himself as if he wanted to be caressed!"

The above brief account of the actions of the Ourang Outang, in the domesticated state, paints in very lively colours, the docility of the animal, and the very strong imitative powers he possesses when these are called into exercise by education; but while we consider the erect position to be a human attribute only, and therefore doubt this animal's capability of walking on his hind legs for any continuance, (however he may have been taught to do so for a short time, in the presence of strangers,) we see nothing in these actions indicative of that intelligence and sagacity which we so often see in the dog, and not unfrequently in the elephant; though, from the deficient resemblance in those two animals, to the human species, they may not appear so striking at first sight, as in the Ourang Outang.

The large African Apes, nnder the denomination of Pongo, which have been mistaken for the Ourang Outang, are stated, by credulous travellers, to be of a very extraordinary magnitude, and to be so powerful, "that ten men are not able to hold them; that if stray Negroes fall in their way, they will attack and kill them: *that they always walk on their hind legs:* that with stones, large clubs, or even with their fists only, they will drive before them the wild elephants; and that they actually attacked two of the Slaves near an English Fort, in Guinea, and would have poked their eyes out with sticks, had not some other Negroes come to their assistance." Most of the accounts I have seen of the larger ape tribes, convey with them, as in the above instance, a mixed proportion of truth, with very questionable probability; and they serve to shew how little we are actually acquainted with the natural habits of animals, whose secluded haunts and extreme wildness of character, render them, not only difficult of approach, by which we could satisfactorily observe their movements, but also prevent us from capturing any of the species excepting, (as before observed,) an occasional young one, whose character has not been fully developed; and which, brought to Europe, from the great difference of the climate, has never survived long enough to make up for this deficiency.

Under such disadvantages, all I can attempt in my history of the Ourang Outang, is to avail myself of the latest, and what may be considered the most authentic information that offers; and I have accordingly, not only consulted systematic writers on zoology of the first respectability, but fortunately have before me some very interesting accounts of this animal, as given by Doctors Abel and Macleod, who returned with Lord Amherst from China; and by Mr. Grant, Assistant Surgeon, upon the Bengal Establishment, whose report appeared in the XVII No. of the Edinburgh Journal of Science, published in July, 1828.

The Ourang Outang seems to be exclusively an inhabitant of the larger islands in the Indian Ocean, within the latitudes approaching the Equator, but principally that of Borneo, and has rarely been captured of a greater height from the crown of the head to the heel, than three feet and a half; that under the observation of Doctors Abel and Macleod, measuring three feet; and the one noticed by Mr. Grant, only twenty-six inches. But as these were considered very young, it is probable they grow to a much larger size. In his physical aspect, the Ourang Outang, it is admitted by all, bears a much stronger resemblance to the human form, than any other animal, but this is only in caricature and in parts; his extreme conformation, taken as a whole, sufficiently evincing his alliance with the brute species. His colour is of a brownish red, the skin below the hair assuming a bluish grey; the whole of the body and extremities, (excepting the face, and palms of the hands and feet,) being covered with thick and straight hair, between five and six inches in length; but it is thickest on the back, arms, and legs, and more thinly scattered over the shoulders, elbows and knees. The face, and the palms of the hands and feet, are quite naked, excepting a few scattered hairs on the cheeks and chin, which give a faint resemblance of whiskers and a beard. The upper portion of the cranium which is covered with the same kind of hair as the body, the forehead, the eyes which are dark and full, with the shape, depth, and direction of their respective orbits, the eyelashes and the ears, are the parts which approach the nearest to man; and these bear that striking resemblance to the human form not easily to be mistaken. But, as we descend from the forehead and eyes, the extreme flatness of the nose, and the oblique and narrow opening of the nostrils, the projecting and mammillary form and the wide aperture of the mouth, diminish the likeness, and at once shew the close affinity of the animal with the brute species. The number of his teeth has hardly yet been defined; the animals hitherto captured, being too young to judge of what that might amount to, in the adult state. The Ourang Outang, described by Dr. Abel, had twenty-four; namely, eight incisors, (the two middle ones in the upper jaw being twice the length of the lateral ones;) four canine, and twelve double teeth. While the animal noticed by Mr. Grant, had only twenty, consisting of eight molars or double teeth, eight incisors and four canine not very white or well arranged, the roof of the mouth being quite black.

Descending from the head, we again find a resemblance to the human form, in the shoulders, neck and chest, though the latter is wide in proportion to the pelvis; in the form of the arms, particularly of the elbows, and in the appearance of the hands, excepting that they are narrower and more elongated than the human, and the fingers more tapering; the thumb being very short, scarcely reaching the first joint of the fore finger. But the arms are long in proportion to the legs, and to the height of the body; and this, with some other circumstances presently to be noticed, is unfavourable to the erect position. All the fingers have very perfect nails; oval in form, and exactly terminating at their extremities. Below the chest, when the animal is in the quiescent state, the abdomen is prominent, and what has been vulgarly denominated, "*pot bellied*," which gives him a grotesque appearance in the sitting posture.

The Pelvis, unlike the human, is narrow and contracted; and this, with the deficiency of the glutœi muscles, and those of the thighs and legs, (the latter being short and bandy,) remove him in the lower portion of his frame, still further from the human resemblance, and disqualify him altogether from walking or resting long in the erect attitude.

The Feet, though resembling man in the palms and in the heels, are both narrower and longer than the human, having distinct fingers in the place of toes, with the great one very short. Those in Dr. Abel's Ourang Outang, being without nails; and those of Mr. Grant, with them. The Ourang Outang has no cheek pouches like the common ape, in which the latter collects his food previously to mastication and deglutition, nor callosities upon the glutœi muscles; but below the chin, he has a double pendulous membrane, which, when the animal is angry or pleased, swells out and gives the appearance of a double chin; and this, communicating with the ventricles of the glottis, produces a thickness and hoarseness of the voice, without, in any degree, (as has been imagined by some naturalists,) approaching to articulation. These external peculiarities are not the only physical resemblances which the Ourang Outang bears to man; for like him, he has an uvula, which no other animal but man and the ape tribes possess; while he resembles him very closely in the structure of the hyoid bone, in that of the liver and of the cæcum or blind intestine, and in the anatomy of the brain, at least more nearly so than any other animal. But, with respect to his walking in the erect attitude, which has been adduced as a confirmatory proof of his still nearer approximation to the human species, however, we may credit his having been taught to do so for a short time, or his having been occasionally seen in the wild state in that position; yet, I consider it to be *physically impossible*, that he can stand or walk erect for any length of time without returning to his natural attitude, the horizontal. Since the width of the chest, compared with the pelvis which is extremely contracted, the shortness of the lower extremities in proportion to the arms, with the great deficiency of muscle in the flanks, thighs, and legs, and the narrowness and length of the feet, all tend to throw the head and body forward when in the erect position, and compel the animal, when walking in that attitude, frequently to return his arms to the ground, to enable him to preserve his equilibrium. This is confirmed by Doctor Abel, who makes the following remarks.

"The Ourang Outang is utterly incapable of walking in a perfectly erect posture; he betrays this in his whole exterior confirmation, and never wilfully attempts to counteract its tendency. His head leaning forward and forming a considerable angle with the back, throws the centre of gravity so far beyond the perpendicular, that his arms, like the fore legs of other animals, are required to support the body. So difficult indeed is it for him to keep the upright position for a few seconds, under the direction of his master, that he is obliged, in the performance of his task, to raise his arms above his head and throw them behind him to keep his balance."

It is the quality of climbing, (and for which, their limbs are so peculiarly adopted,) and not the erect position, which is the attribute that nature intended the Ourang Outang, and all the ape and monkey families, exclusively to possess; as fully confirmed by the authorities which we have previously quoted, as well as by every individual who has seen them in their wild state; and in this action they seem to excel all other animals; running up with the greatest facility, the rigging and masts of vessels, and the tops of houses, when under human protection; and in their native regions, the loftiest trees; and making their summits their nightly abode. Thus the forests, form the principal haunts of this extrardinary race of animals, and in these, and in their vicinity, they find the fruits, the eggs of birds, the insects, and the seeds of vegetables, from which their food is derived; and it is in these recesses that their young are brought into life, and protected until they can help themselves. But all these are physical circumstances only. The most important fact to be determined is, how nearly the Ourang Outang approaches our own species in those intellectual qualifications, which have elevated man very far above, and have bestowed on him that superiority, which he possesses over every other part of the creation.

And here we are of opinion it must be admitted, that he falls very short of what might be expected from him, upon taking a hasty view of his physical resemblance. For though he soon after being captured, becomes docile and tractable, shews great affection towards those who treat him with kindness, displays much cunning and adroitness in every thing which regards himself, and is very readily instructed in many of the common actions belonging to our species, of which we have given from Buffon some very illustrative proofs; yet he betrays little of that comprehensive intelligence and sagacity, which alone can render the brute animal interesting, and which, in so many instances, have nearly placed the dog upon a footing with ourselves; at one time, the most amusing of companions, at another, the sure and faithful defender of our lives and properties.

The actions of the Ourang Outang are therefore to be attributed either to his imitative powers, of which he possesses a very extraordinary share, or to his instinctive ones; producing in him that animal sagacity and cunning, which lead to a variety of movements, rarely to be observed in any other quadruped.

I have formed this opinion, not only from my own observations on the Ape tribes in general, (of which the Ourang Outang may be considered a variety,) but from the best accounts which I have been enabled to consult on the subject, but more especially from the recent reports of Doctors Abel and Macleod, and Mr. Grant, (already alluded to,) in which have been noticed, many interesting anecdotes of this animal, all confirmatory of this opinion, but which, I regret, the limits of my lecture will not permit me to detail.

I only beg to remark, that however for reasons which cannot be brought within our limited comprehension, the Ourang Outang bears in certain parts of his physical conformation, a striking resemblance to man, and mechanically can imitate him in many of his actions; yet I trust it will appear, that he is most obviously placed at an immeasurable distance from him, in all those nobler qualifications for which man is so pre-eminently to be distinguished; in the uniformly erect attitude of his body; in his bold and commanding gait; in the comprehensive and complicated uses which he makes of his hands; in the power he possesses of communicating, and receiving ideas, through the medium of speech; and more especially in all those inventive and highly intellectual endowments, which have more or less rendered subservient to human will and pleasure, every other part of the animal kingdom—Thus the boasted hypothesis of the several parts of the creation being united by one chain of which man is only the first in the link, exists but in the imagination of a few fanciful philosophers; while, in the estimation of the best informed naturalists, he holds a distinct and separate place; at once the arbiter of the surrounding objects, and the no mean conterpart of the divine architect, at whose mandate, man, and all living things, were first called into existence.

With reference to the usefulness of the various animals belonging to the Ape genus, it is not to be expected, under our present short-sightedness, that we should be able to ascertain the positive object of each part of the creation; nor to determine at all times, how far an obvious evil has been compensated by a corresponding good. It is sufficient that our general experience has taught us, that nothing has been created in vain, and that in few instances has a great inconvenience been produced without having some useful tendency in view.

This observation has been fully corroborated in the habits of the animals, to which we have alluded; whose well known disposition to destroy by waste and otherwise, the produce of the countries which they inhabit, is more than counterbalanced by the distribution in every direction, and by burying in hoards, at distant points, the seeds of the fruit and vegetables which they consume; thus becoming eventually, and comprehensively, the cultivatiors of the soil to the productions of which they appear to be the greatest enemies; and thus the more we examine into the works of nature, the more fully are we convinced of their utility, even in her minutest operations.

Of the next genus in the order of Primates, *the Lemur tribes*, our notice will be but brief; as the animals belonging to it, have nothing very remarkable in their habits to render a long detail of their history necessary. One or two species are to found in Africa and South America, but they principally inhabit the Indian Islands, more especially Madagascar and Ceylon.—From their quadrumanous structure which increases their faculty of climbing, and from their haunts and habits being confined to the forest where they obtain their food, they have been classed by some naturalists with Monkeys; but as they differ from them in the arrangement of their teeth, in the form of the head which is fox-like and in the greater length of their legs; Linnæus has, with more propriety, placed them in a separate genus.

We come now to the last genus in the order of Primates, *the Bat tribes*, which, though possessing a very curious piece of mechanism that confers upon them the quality of flying, thus apparently forming a link between quadrumanous animals, and birds, renders them a fit subject for philosophical inquiry; yet upon a closer examination we shall find, that even this attribute has been but imperfectly bestowed; and that, in every other particular, they have all the distinguishing qualities of the other animals in the same class, though very few that entitle them to be placed in the order of Primates.

The Bat is an inhabitant of every known portion of the world, and is the only wild Mammiferous animal that has been seen in the Pelew Islands, excepting latterly, a few Rats of the European species, which are supposed to have been imported by vessels which have visited the Islands from Europe. It varies in size from the smallest mouse to the full grown rabbit, and increases in magnitude as the temperature advances, so that in the equatorial latitudes, it becomes a very formidable animal.

Of this genus, there are in all, thirty species, of which, four are to be found in Great Britain, namely, *the short eared or common; the long eared; the noctule, or great; and the horse shoe Bats.* But it will sufficiently answer our purposes of illustration, to notice only two; *the common European Bat* which is the smallest, and *the Vampyre or Spectre,* which may be considered one of the largest of the Bat tribes; more especially, as the leading observations we shall have to offer upon these two species, will apply to the whole genus.

The Short Eared, or Common European Bat, which, when flying about our houses and barns, or among old ruins, so often attracts our attention, is about the size of a young mouse, to which, with the exception of its wings, it bears no small resemblance; and from this circumstance, and from its mode of flying, it has been familiarly called *the Flitting Mouse.*—It is about two inches and a half in length, and measures nine inches from wing to wing, when fully extended. The colour of its fur, is that of a mouse tinged with red—its ears are very short and small, and have each an inner valve—the eyes are very minute, and the mouth, nose, and head, generally resemble the mouse.—It has four incisors, or cutting teeth, separated in couples in the upper jaw; and six incisors, sharp-edged, and triflingly notched, below; with one canine tooth between the molars and incisors, in each jaw.—Its tail is short, and forms a part of the wing when the animal is flying, so that it is not seen in that attitude.—Its hind legs which are extremely weak, are divided into five toes or fingers of equal length, and all of them armed with nails terminating in sharp claws, that assist its motion when on the ground, and serve the purposes of suspension, when it returns to its winter abode.

But the most curious and most interesting part of the animal's mechanism, is the instrument by which it is enabled to fly; and this leads me to the consideration of the fore legs and feet, or rather hands, by which the principal actions of the animal are produced.

Contrary to the hind extremities, (just described,) which, in most particulars, resemble those of the other quadrumanous animals; the bones of the fore arms and fingers of the Bat, (with the exception of the thumb, which is short, detached, and armed with a hooked nail,) form thin, and long continued processes; having the intervals between, filled up by a very fine, transparent, umbrageous, and sail-like membrane, which extends to the muscles of the breast bone, and to the hind legs and tail, thus enveloping as it were, nearly the whole animal, and giving it, while on the ground, incumbered as it is by its folded membrane, a very unseemly and awkward appearance, more especially when it attempts to walk, which it finds some difficulty in accomplishing. But upon its ascent, (to effect which, it is necessary to attain some point of elevation,) it assumes, altogether, a new and highly interesting character. For the elongated fingers, acting as yards to a sail, become, at the will of the animal, very widely extended; and the whole membrane throughout, thus put upon the stretch, is converted by the joint action of the pectoral muscles, into a beautiful pair of wings of very considerable expansion, which, being rapidly thrown into motion to preserve the animal's equilibrium in the air, give to it the flitting appearance, that so strikingly attracts our attention. For, unlike the bird, it can neither suspend its motion to afford time for rest, nor can it continue long in the flying attitude, but is compelled to move very rapidly, and to resort frequently to the ground, or to some eminence, to renovate its powers, very easily exhausted by these exertions.

It consequently can rarely reach any considerable elevation in the atmosphere, and therefore confines its flight to the space between the lower portions of the roofs of houses, barns, and the vicinity of old ruins, in pursuit of small summer insects, and moths, (its usual food,) carefully avoiding its greatest enemy, the owl; and, as we have just observed, frequently resting upon little eminences to recover the powers of flight.

But it is only during a few months of summer, that the bat is capable of exertion. It soon loses its energy as the season becomes cooler, and upon the approach of winter, it retires to caves, old ruins, or the hollow parts of trees, where, in a completely torbid state, it is often seen suspended by its hinder legs, or by the hooked nails of its thumbs, huddled together in clusters of considerable numbers. In this condition, as Mr. Bingley observes, "most of the animal functions are so far suspended, as to be scarcely perceptible. The action of the heart and arteries becomes so exceedingly languid, that the pulse can hardly be felt. If respiration be at all carried on, it is also so very slow, as to be scarcely discernable. The natural temperature, or animal heat, sinks greatly below the usual standard, and digestion becomes altogether suspended. All the visible exertions are at a stand, and none of the functions seem to go on, excepting a very small degree of nutrition, and an interchange of old for new matter, in the depository cells of the body."

The female has two young ones at a birth, large in proportion to the size of the mother, and which hang close to the nipples, even when the animal is flying, so that the Bat hardly seems to stand in need of a nest, to which most other animals resort for the protection of their young; and it has the additional peculiarity of not only finding its way in the darkest night, but also in a labyrinth, or in any crooked or contracted place, even when deprived of its eyes; a circumstance which has been attributed to the extreme sensibility of its membranous wings, or to a more acute hearing, that renders it susceptible of the diversity of impulsions communicated by the external air.

Naturalists have been divided on the nomenclature of the large Bats of foreign countries, more particularly as referable to the term *Vampyre*, which, by some, has been applied equally to the Asiatic and American Bats, and by others, has been confined to the former, while the latter has been denominated the *Spectre* Bat. As my time will not permit me to enter into a particular history of each of the foreign Bats, I shall confine my description to the large Bat of South Americ , to which I shall take upon myself to to assign the name of *Vampyre;* briefly observing, that the largest Bats are to be found in the Island of Java, some of which, have measured one foot in length, and more than five feet from wing to wing, when fully expanded; and that though these are stated to live upon the fruits of the country which they inhabit, yet, from the peculiar structure of the tongue, we can easily credit the propensity which has been attributed to all the foreign Bats, that of sucking the blood of the animals, upon whom they may have it in their power to fix.

The specimen on the table which was presented to the Society, by Mr. Cole, though from being brought from India in Spirits and afterwards dried, it has failed to display its nature, size, and form; will serve to convey to you some general idea of the magnitude of these animals.

The Vampyre Bat, of South America, which is found chiefly in Surinam and Guiana, is about the size of a Squirrel, and measures from tip to tip of the wings, when expanded, nearly three feet. Its body is covered with long hair, of nearly a black colour, and it has no tail. It has four incisor teeth in each jaw, according to Linnæus, but Stedman gives it four in the upper, and six in the lower jaw, with large solitary canines or tusks, and many obtuse grinders. The nostrils in front resemble a funnel, bending upwards into a ianceolated leaf, where it forms a thick and elongated kind of cushion with membranous edges, that altogether give the animal that hideous aspect, which has so much attracted the attention of travellers.

Its tongue is very remarkable, representing in length and narrowness, the tongue of the Ant Eater, which, like that animal, it has the power of thrusting out very far. Its surface is lightly shagreened, and close to its extremity, may be seen an organ which seems adapted to suction, as it consists of a cavity terminating in a point, the circuit of which is marked by eight warts. The remaining portion of its conformation, differs only, in a few particulars, from the other Bats, which, however unseemly in their appearance, bear no comparison with the Vampyre Bat of America; whose hideous and disgusting aspect, combined with its established propensity to suck the blood of other animals, (the human subject not excepted,) has rendered it the just object of terror to those strangers who have visited the countries in which it is to be found.

That the Vampyre Bat has this propensity, has been confirmed by the testimonies of the most respectabe travellers, but more especially by D'Azzara, Condermine, and Stedman, all of whom are to be depended upon for their authenticity.

From D'Azzara, we have the following remarks. "The species, with a leaf upon the nose, differs from the other Bats, in being able to turn when on the ground, nearly as fast as a rat, and in their fondness for sucking the blood of animals. Sometimes they will bite the crests and beards of the fowls while asleep, and suck the blood. The fowls generally die in consequence of this, as a gangrene is engendered in the wound."

"They bite also Horses, Mules, and horned cattle, and usually prefer the flanks, shoulders, or neck, as they are better enabled to arrive at these parts by the mane and tail. Nor is man himself secure from their attacks. On this point indeed I have been enabled to give a very faithful testimony, since I have had the ends of my toes bitten by them four times, while I was sleeping in cottages in the open country. The wounds which they inflicted without my feeling them at the time, were circular or rather elliptical. Their diameter was trifling, and their depth so superficial, an scarcely to penetrate the cutis. It was easy also on examination to perceive, that these wounds were made by suction, and not by puncture, as might be supposed. The blood that is drawn in cases of this description, does not come from the veins, or from the arteries, because the wound does not extend so far; but from the capillary vessels of the skin extracted thence without doubt, by those Bats, by the action of sucking or licking."

Captain Stedman,) whose veracity has been pledged in the XXII. Volume of the Monthly Review,) appears to have been more severely handled by one of these Bats, than D'Aizzara, for he says in his account of Surinam, "I cannot here forbear relating a singular circumstance respecting myself, namely, that on awaking about four o'clock this morning, in my hammock, I was extremely alarmed at finding myself weltering in congealed blood, and without finding any pain whatever. Having started up and run for a Surgeon, with a fire brand in my hand, and all over besmeared with gore, to which, if added, my pale face, short hair, and tattered apparel, the Surgeon might well have asked the question, 'be thou a spirit of heaven, &c.' The mystery however was, that I had been bitten by the Vampyre, or Spectre of Guiana, which is called *the Flying Dog* of New Spain, and by the Spaniards *Perrovolador*- This is no other but a Bat of monstrous size, that sucks the blood from men and cattle, when they are fast asleep, even sometimes till they die; and as the manner in which they proceed is truly wonderful, I shall endeavour to give a distinct account of it. Knowing, by instinct, that the person they are going to attack, is in a sweet slumber, they generally alight on the feet, and, while the creature continues fanning with his enormous wings which keeps one cool, he bites a bit out of the tip of the great toe, so very small indeed, that the head of a pin could scarcely be received into the wound, which is consequently not painful; yet through this orifice he continues to suck until he is obliged to disgorge. He then begins again, and thus continues sucking and disgorging till he is scarcely able to fly, and the sufferer has often been known to sleep from time into eternity. Cattle they generally bite in the ear, but always in those places where the blood flows spontaneously. I observed several small heaps of congealed blood all round the place where I had lain upon the ground, upon examining which, the surgeon judged that I had lost at least twelve or fourteen ounces during the night."

Another instance of the kind is noticed in Mr. Waterton's Wanderings in South America, in which it is mentioned, that a gentleman by the name of Tarbat, had lost nearly twelve ounces of blood from his great toe, by the bite of a Vampyre Bat, in Demerara, while sleeping in the thatched loft of a Planter's cottage, near the River Paumaron.

Thus the Bat, which, diminutive in size and inoffensive in character, only excites, in this milder climate, a pleasing interest from the peculiarity of its structure and its habits; is rendered, by the high temperature of tropical latitudes, an animal comparatively of vast magnitude, disgusting in aspect, and most truly formidable in its propensities, which are rendered the more dangerous from the invidiousness of the attacks, by which the sufferer is totally unprepared to guard against the evil.

In closing my account of the Bat, I may be permitted to observe, that since this animal was destined to derive the principal part of its food from night insects which frequent the lower portions of the atmosphere in the vicinity of buildings, we cannot but admire the peculiar mechanism of its structure, by which the Bat is to be distinguished from every other animal, and through whose agency, those various actions, (so necessary to its preservation,) could alone have been performed.

Thus, throughout nature's works, however diversified in their forms, or opposed to each other in their object, we uniformly see the same adaptation of the means to the end; and though various instruments have been employed, we find one general effect to be the result, *namely, the harmony of the whole.*

In the second order of Linnæus, the animals are distinguished by having very powerful grinders, without front teeth in either jaw, and by their feet being fortified with strong, blunted, hoof-like nails; and as these of the animals are clumsy in their make, and slow in their motions, this order has been denominated, *Bruta*. It consists of eight Genera, namely, *the Rhinoceros the Elephant, the Walrus, or Sea Horse, the Sloth, the Ant Eater, the Manis, the Armadillo, and the Platypus, or Duck's Bill Animal*; of which I have selected the Elephant and Platypus for particular description; the first being rendered highly interesting from the peculiarity of its structure, and more so, from its superior intelligence; the latter, from its conformation being opposed to every other animal; having a bill like that of the Duck species, engrafted on the head and body of a quadruped.

The Elephant is the largest of existing quadrupeds, and exceeds in magnitude every other known animal but the Whale. He is an inhabitant of the hottest latitudes of Asia and Africa, the chief distinction of whose Elephants is to be observed in the more or less arched form of the head, in the shape of the teeth, and in the size and quality of the tusks.

He has never been seen in the wild state, either in Europe or America, though it is well known that fossil remains of very large Elephants, and of several other tropical animals, are frequently to be met with in the upper formations of both those portions of the globe, and in many parts of this country in particular.

His usual range is in the thick forests of swampy grounds, or on the banks of rivers, where he is often to be seen in considerable herds (for he is a gregarious Animal) either feeding on the leaves and branches of young trees, or passing through the intermediate streams, in which, with his Proboscis out of the water, he swims with great facility; but his food is not confined to the foliage of trees, for he partakes of any vegetable substance that may fall in his way.

Upon our first notice of this animal, we are very forcibly struck with, and surprised at, his vast height and magnitude. But an immense and unwieldy body arched in the centre of the back and very scantily covered with hair; a course and highly wrinkled skin of a dirty hue; a small disproportioned tail, hanging like that of the hog; thick, and clumsey legs, ungracefully placed on the ground; and a head which, with broad pendulous ears, and diminutive eyes, terminates in a tube, or proboscis of very considerable extension, are all circumstances by no means calculated to improve upon the impression; and it is not until we have observed the intelligent expression of his eye, and the sagacity of his movements, that his exterior deformities are forgotten in our admiration of an animal, which, with physical powers few competitors could resist, can with facility be rendered as docile and as obedient as the dog; and can be taught to perform actions which appear to require the human intellect to comprehend.

In confirmation of his great magnitude, an Elephant of the largest size has been known to exceed seventeen feet in length, from the crown of the head to the tail; fifteen feet in height from the arch of the back to the soles of the feet; six feet in the circumference of his legs; and to weigh more than ten thousand pounds. But the common averaged proportion of the Elephants which have been seen in this country, may be taken at about one third of the above dimensions and weight, and even this implies a vast degree of animal bulk.

His skin is commonly a brownish grey, or tawney, but in the animal we have recently witnessed, it was a dark brown nearly approaching to black.—It is throughout extremely wrinkled and knotty, full of deep furrows resembling the back of an old oak tree, and appears at first sight to be altogether naked; but upon a closer examination it is found to be thinly covered with short hair—Its texture is unusually dense and thick, and so resisting, as often to be impenetrable to the largest sized musket ball, and yet indued with so much sensibility, that the smallest insect upon it occasions the greatest uneasiness.

His head appears, at the upper part, to be large and capacious in proportion to his face, and being arched as it descends,* gives a peculiar aspect as it tapers off towards the Proboscis, more particularly when combined, (as we have just observed,) with broad, pendulous ears, comparatively small eyes, and a half concealed mouth, thrown into the back ground by the prominence of the tusks and proboscis.

Like the other animals belonging to this order, the Elephant has no incisors, or front teeth, but usually four large molars, or cheek teeth in each jaw, two in each side, closely united together, and forming with the jaw bone, apparently one compact mass of considerable bulk and weight. His lower jaw is without canine teeth, but this deficiency is amply made up by those which issue on each side from the upper jaw, which, projecting out from below the base of the proboscis, like horns with curled fibres, add much to the peculiarity of the external appearance of the Animal. These tusks in the full grown Elephant, are from five to eight feet in length, and weigh from one hundred to a hundred and fifty pounds each; and as they form the best Ivory of the shops, they are considered, in a commercial view, of great value.

But the most interesting and most important part of this animal, is his proboscis or trunk,

* We allude to the African Elephant.

which, while its extremity serves the prehensive purposes of the human hand, and the tube generally to raise or to strike bodies at the pleasure of the animal; is the instrument through which respiration is performed, and food and water conveyed into the mouth; and the channel of communication with the nasal apparatus by which smelling is affected (a sense in this animal of very peculiar acuteness and discrimination) but is not in itself the organ of smell.

This very extraordinary apparatus, which is convex on its upper surface, and flat below, is about three feet in length, when contracted, and exceeds nine feet in its fullest extension—It is composed of a series of flexible,cartilaginous rings to which are attached innumerable transverse and longitudinal muscles most curiously interlaced with each other, through whose agency at the will of the Animal, an almost endless variety of actions can be produced; the whole forming as it were an irregular cone commencing with a broad base and terminating in a tapering extremity.

It takes its rise from the nasal and upper maxillary bones, and making a turn inward, it descends into the palate, where it forms separate orifices; being the commencement of distinct cavities, which are divided quite up to the extremity, by a longitudinal partition; thus forming a completely double tube.

Near the internal nasal openings, there is a moveable, cartilaginous plate, which enables the animal to shut the communication with those cavities at pleasure, and thus prevents the water with which it occasionally fills the trunk, from entering into the nasal passages; while from having the power of moving the proboscis in all directions without closing at the same time both the internal cavities, respiration is not interrupted, and water, when received into the tubes, can be allowed to remain until the animal chooses to throw it out by expiration, and thus either to convey it into the mouth when it wishes to drink, over the whole head and body for the purpose of ablution, or to force it in every direction to a considerable distance from him, when he has no longer occasion for its use, or to punish those with whom he may accidentally be displeased.

At the further extremity of the proboscis, there is a concave protuberance the superior part of which is extended several inches beyond the inferior, together forming with the rough edges of this bulb, a prehensive organ, that, like the human fingers and hand, is capable of grasping any substance which the Elephant may wish to take up.

This part of the proboscis is therefore used to absorb and pour into his throat water, when he wishes to drink, to break off and convey to his mouth, the larger branches of trees, which are is his natural food, or the leaves and stems of the plantain ; and when domesticated, to take up and convey in the same manner, grains of corn, blades of grass, hay, and other vegetables with which, when tamed, he is usually fed ; or he can be taught to pick up with it, small pieces of straw, or pins to untie knots, and to unbar and to open gates; and with his proboscis generally, to raise up and assist in loading himself with very heavy articles, or to remove them back again to the ground, or to carry upon it, (for the conveniency of his employers) small packages ; and with the same instrument he can inflict deadly blows upon his enemies, when placed on the defensive.

Thus, by a wise dispensation of Providence, a most curious piece of mechanism has been given, which, while all the necessities of the Animal have been most amply provided for in a manner that considering his great bulk and general make, could not have been effected by any other part of his conformation ; it contributes by the intelligent use which he makes of it, to a variety of human accommodations ; and this, together with the great strength of his body, and his capability of performing long journies under very heavy loads, has rendered the Elephant the most valuable of Animals in the countries in which he is to be found.

The female Elephant is supposed to carry her young about twenty months, rarely producing more than one at a time. These use their mouths for sucking, throwing their proboscis over their heads while under that operation, so that it is not until after lactation has ceased, that this instrument is called into comprehensive action.—At the time of birth, the Elephant is about the size of a full grown calf, and as he is supposed to continue growing for upwards of twenty years, we may easily comprehend the great magnitude to which he can reach.—He is known to be a long lived animal and frequently to have exceeded the hundredth year of his age; but it is conjectured, in his natural state, he lives to a much greater period.

In former times he was used by the Natives for the purposes of war and was armed accordingly; and the Carthaginians availed themselves of this animal to assist in their various operations against their Roman enemies.

In the military operations of the present day, he is only employed as a beast of burden to convey the artillery, ammunition, and Camp Equipage, with the usual appendages of an army, and in this particular he proves of the most important utility. But it is in a commercial point of view, that the labors of the Elephant are the most comprehensively employed; since it is upon his back, that the tuns, sacks, and bales, in short all the articles of merchandize are transported from one part of India to another; that whole families are conveyed upon one single animal upon the same rout; and that whether in drawing or carrying the most weighty articles, he can travel at the rate of fifty miles a day, over tracks of country, in which all other beast of burden would sink under the exertion.*

Thus from his strength alone, it is calculated that he can carry and draw more than six horses; and every part of him from the extremity of his back to his trunk, is in some way or other called into active utility.—This noble animal therefore has a peculiar claim upon our attention and gratitude; since while he affords proofs the most convincing, that Providence has in all instances guarded against the inconveniences of locality, and beyond doubt to each animal has allotted some useful place according to the climate and circumstances of the country which it inhabits; the services of the Elephant are in every possible way of the most efficient character, and such as in the present state of our Indian settlements could not be dispensed with, but at the loss of our commerce and probably of the territory from which that commerce has been derived.

* The Arabian Camel is also used as a beast of burden in India, but only for subordinate purposes, and where less expedition is required.

But it is only in Asia, that the Elephant is thus tamed and domesticated for useful labors. In Africa he is hunted and destroyed for the sake of his tusks; and as the Ivory of the latter country is of a superior quality to that of Asia, it forms a leading article of African commerce.

The sagacity of this noble animal, has been illustrated in a variety of instances, which it is impossible to bring within the scope of a Lecture, intended to take only a general view of Animal History.

They are no doubt well known to many of those who are now doing me the honor to hear me; and they have been interestingly detailed in Buffon's Natural History, in Bingley's Animal Biography, and in most of the respectable Encyclopœdias. We shall briefly observe, that, limited as is his education has been, to the performance of a few actions to render him useful as a beast of burden, or to serve the purposes of a public exhibition; he displays a wonderful falicity in comprehending what has been taught him, and well and effectually performs his task according to the orders received. Thus his natural docility of temper, leads him to be easily tamed and domesticated, when he soon forms a lasting affection for his master, in whom he readily learns to discriminate the different modulations of his voice, if not to understand his distinct articulations; the meaning of the varied expressions of his countenance, or the wishes conveyed by his hands; so as by a word, a look, or a sign, to produce that immediate execution of an order, which in most other intelligent animals, requires a combination to have the same effect.

Thus he is taught to kneel down to receive his load, or to use his proboscis to remove it when already placed on his back; to avoid wet in the spot in which it is to be deposited; or to remove with his trunk any obstacle that may stand in his own way, or in that of his master; to unbar and open gates, or to untwist the knots of ropes; to loosen shoe buckles, or to pick up the most minute article from the ground, and to place it in the pocket of those who are nearest to him, or to remove an article from the pocket of one person and to place it in that of another; to be guided without a bridle, by a driver on his neck with only a pointed rod, or to move even by words only, in any direction, or at whatever place, his rider may think proper to order, and to stop the moment he receives the command, by the articulation of one short monosyllable only.

In thus detailing the sagacity of the Elephant, it is but right to mention that much difference of opinion exists, as to the degree of intelligence which ought to be attributed to that animal; some considering the actions of which he is capable of being taught, as merely mechanical, the result of coersion, and of subsequent habit. But what would Man have been without example and instruction, of which it is his capability alone that renders him susceptible? And how does it happen, that so overwhelming a proportion of the brute species, is totally incapable of being taught even the most common actions; while a few others, from their quick apprehension can readily be instructed in a variety of movements, and can understand by word of mouth, by a sign, or by a look, what particular action they are to perform, and vary them according to circumstances, or even produce the same actions, as it shall please them, when no command has been given? This ready apprehension therefore, I should denominate, *Intelligence*, to distinguish it from *Instinct*, or from being the result of merely acquired habits; though it is far removed from that higher order of Intellect, denominated *Reason*, which, leading to a just application of animal actions to the most useful purposes as suggested by reflection, is rarely to be met with but in the human species. It is the first kind of intelligence as produced by a ready apprehension that the Elephant possesses in so preeminent a degree, and such as perhaps not often to be equalled by any other quadruped; and if with this, we allow him a limited share of reflection, we shall probably have brought his character, as nearly within the truth, as our confined knowledge of the subject will admit.

But his natural docility of temper is sometimes interrupted by temporary fits of insanity, which render it extremely hazardous to approach him. This was fully verified in the noble Elephant, then the property of Mr. Cross, of Exeter Change, and which formerly was exhibited on the stage, carrying on his back that accomplished actress, *Mrs. Henry Johnson* in the Pantomine of Harlequin *Padmanaba*. He at that time was a most docile and sagacious animal, and from his great size and various performances, had attracted much of the public attention. He was a native of India, and measured from ten to eleven feet in height, and weighed at least by computation, between four and five tons; consuming daily, three trusses of hay, about two hundred weight of carrots, and from sixty to eighty gallons of water, partly used for drinking, and partly for ablution.

It was about seven years ago, when he first exhibited those symptoms of the malady, which afterwards for security sake rendered it necessary to destroy him.—At the period now alluded to, the keeper having gone into his den to exhibit him, the animal refused obedience, and on striking him with a slight cane as usual, the Elephant violently threw him down.—Another keeper seeing the danger, tossed a pitch fork to his comrade, which the animal threw aside like a straw. A person then ran to alarm Mr. Cross, who hurried down stairs, and catching up a shovel, struck the animal violently on the head, and suddenly seizing the prostrated man, dragged him from the den, and thus saved his life.

By active remedies, the symptoms of insanity were for a time abated, but they seemed to have increased upon him in duration in each succeeding year, until the year 1827, when one day at the latter end of February, wholly unprovoked, he made a most desperate rush at the front of his den, and so weakened the security of it, as not only to threaten his immediate escape, but by the repeated lunges he made, he incurred the risk of breaking down the other parts of the building in which the ferocious animals were secured and of thus endangering the whole neighbourhood. Mr. Cross, therefore very painfully to himself, (for independently of the great value of the animal, he was much attached to him) determined that he should be destroyed.—At this period, his eyes glared like lenses of glass, reflecting a red and burning light; and from his furious actions, and great bulk, (being nearly five ton,) all pressing against a very insecure confinement, every thing was to be apprehended so long as his life was continued—Very active poisons, in disguise were therefore first offered to him, but these he had the sagacity to detect and refused them accordingly. Recourse was then had to fire arms, swords, and pikes, ; but it was not until after more than an hour's conflict, during which 130 musket balls were expended, and most desperate wounds from swords and pikes inflicted, that this noble animal, once the pride of his master and the admiration of the public, was effectually destroyed, after endangering the demolition of the whole building. More circumstantial information on this transaction has been given in the third volume of Mr. Griffith's illustration of Cuvier's animal Kingdom, to which we are indebted for the preceding account.

We have been led into this detailed history of the Elephant, to afford an opportunity of evincing how very limited are the rational powers of even the most intellectual quadrupeds, of which the Elephant may be considered as one, when compared with those of man; and how strictly this qualification, in the former instance, has been confined to the wants and necessities of the animal, or if more extended, to the obvious accommodation of our own species. For though throughout the various orders we may observe a regular chain of instincts, distinguished in several of the species, by great sagacity and contrivance, and in a few, by a certain portion of reason, which had it been capable of full cultivation might have brought the brute animal upon a level with man; yet nature has so clearly drawn the line of distinction, as at once to break in upon the association; since by confining all improvement of intellect in such animals to their own common wants, and to their general usefulness; and by conferring on the mind of man an unbounded capability of cultivation; she has rendered all near approximation of the brute to the human species, morally impossible; and hence that pre-eminence which uniformly has distinguished Man from every other part of the creation.

These reflections would have led us, had our time permitted, to have entered into a comparative view of instinct and reason as applicable to the brute species; a most highly interesting subject, and affording a noble scope for the investigation of the philosopher. We can *now* only briefly observe, that we consider instinct to be that inherent propensity to various actions, which are indispensible for the preservation of the animal and its offspring under all the ordinary contingencies of their existence, and therefore however differing in each individual, it is uniform in its operation and effects, and can never be altered.

Reason, on the contrary, is limited to the production of those actions that are excited by *accidental* circumstances, and which are not necessarily connected with the natural habits and wants of the animal. It therefore depends upon the capability of each animal to receive new impressions from external agents, and *by the aid of reflection*, to act accordingly. Hence education and example, with reflecting powers, are essential to the developement of the one quality, natural propensities are sufficient to give effect to the other; and hence we find in the Brute Animal, instinct is *throughout life* the predominant impulse, while in the human subject, early instincts gradually give way to the progressive advancement of the reasoning faculties.

We come now to the history of an animal, and which, by the permission of a friend, is presented to you for observation, whose peculiarity of conformation led many naturalists in the first instance to suspect, that the early specimens sent home, were impositions; but the animal since has been sufficiently identified, to remove all doubts upon the subject.

It was at first denominated by Dr. Shaw *the Platypus, or Duck's Bill Animal*; but other naturalists have very generally admitted the appellation given to it by Blumenbach, who has denominated it *Ornithorynchus Paradoxus*, and has placed it in his order of *Palmata*, or *web-footed;* while Cuvier has made it to belong to his *Edentata*, or animals that have few, or no teeth.

This extraordinary Animal, which is only to be found in the rivers and lakes of New South Wales, is about the size of a moderately grown kitten, and is distinguished from all Mammiferous Animals, by the peculiar formation of its mandibles or jaws, which resemble, in every particular, the broad, flat bill of the Duck tribes, are similarly covered with a soft membrane, and like the bill of the Duck, their lateral edges are serrated.—All the feet are webbed, the webs on the front feet projecting beyond the claws, by which means they can be folded up,or expanded, at the pleasure of the animal.

This animal is an expert swimmer, and is frequently seen on the surface of the water which it seldom quits, blowing like a turtle.—But as it is from Dr. Shaw that we have the fullest account of *the Ornithorynchus*, we shall introduce it in his own words, as published in his Naturalist's Miscellany.

"Of all the Mammalia yet known, this animal seems the most extraordinary in its conformation; exhibiting the perfect resemblance of the beak of a duck, engrafted on the head of a quadruped.—So accurate is the similitude, that at first view, it naturally excites the idea of some deceptive preparation by artificial means; the very epidermis, proportions, serrations, manner of opening, and other particulars of the beak of a Shoveller, or other broad billed species of Duck, presenting themselves to the view; nor is it without the most minute and rigid examination, that we can persuade ourselves, of its being the beak or snout of a quadruped."

"The body is depressed, and has some resemblance to the Otter in miniature; it is covered with a very thick, soft, and beaver-like fur, and is of a moderately dark brown above, and of a subferrugenous white beneath.—The head is flattish and rather small than large; the mouth or snout, as before observed, so exactly resembles that of some broad-billed species of Duck, that it might be mistaken for such. Round the base is a flat circular membrane somewhat deeper or wider below than above; below, near the fifth of an inch; and above, about one eighth.—The tail is flat, furry like the body, rather short and obtuse, with an almost biped termination; it is broader at the base, and gradually lessens at the top, and is about three inches in length; its colour is similar to that of its body. The length of the whole animal, from the top of the beak to that of the tail, is thirteen inches; of the beak, an inch and a half.—The legs are very short, terminating in a broad web; which, in the fore feet, extends to a considerable distance beyond the claws.—On the fore feet are five claws, straight, short, and sharp pointed; the two exterior ones, somewhat shorter than the three middle ones.—On the hind feet are six claws, longer and more inclined to a curved form than those of the fore feet.—The exterior toe and claw, are considerably shorter than the four middle ones; the exterior, or sixth, is seated much higher than the rest, and resembles a strong sharp spur.—All the legs are hairy above; the fore feet are naked both above and below.—The internal edges of the under mandible or jaw (which is narrower than the upper,) are channelled with numerous striæ as in a Duck's bill. The nostrils are small and round, and are situated about a quarter of an inch from the tip of the bill, and are about the eighth of an inch distant from each other.—There is no appearance *of teeth*; the palate is removed, but seems to resemble that of a Duck; *the tongue* also is wanting in the specimen.—The ears, or auditory foramina, are placed about half an inch below the eyes.—They appear like a pair of oval holes about the eighth of an inch in diameter, there being no external ear.—A little beyond the beak, are situated two smallish, oval, white spots in the lower part of which are imbedded the eyes, or at least the parts allotted to the animal for some kind of vision; for from the thickness of the fur, and the smallness of the organs, they seem to have been but obscurely calculated for distinct vision, and are probably like those of the Mole, and some other animals of that tribe; the whole apparent diameter of the cavity in which they are placed, not exceeding the tenth of an inch."

"When we consider the general form of this animal, and particularly its bill and webbed feet, we shall readily perceive that it must be a resident in watery situations; that it has the habits of digging or burrowing in the banks of rivers or under ground, and that its food consists of aquatic plants and animals.--This is all that at present can be reasonably guessed at.--Future observations made in its native regions, will, it is hoped, afford us more ample information, and will make us fully acquainted with the natural history of an animal, which differs so widely from all other quadrupeds, and which verifies in a most striking manner the observation of Buffon, namely, that whatever was possible for nature to produce has actually been produced."

"On a subject so extraordinary as the present, a degree of scepticism is not only pardonable but laudable; and I perhaps ought to acknowledge, that I almost doubt the testimony of my own eyes, with respect to the structure of this animal's beak; yet must confess that I can perceive no appearance of any deceptive preparation; and the edges of the rictus, the insertion, &c. when tried by the test of maceration in water, so as to render every part completely moveable, seem perfectly natural; nor can the most expert anatomist discover any deception in this particular."

Since the above account of Dr. Shaw was published, in which it is stated, that no teeth or tongue could be discovered in the Ornithorynchus, this animal has been very closely examined by other naturalists, and particularly by Sir Everard Home, who has stated his opinion, that the oblong verticle fibres to be observed towards the lower part of the cartilaginous edges of each mandable, and consisting of horny substances with a flat surface, simply adhering to the gums and without fangs, are to be considered as molar teeth; and that he has discovered a short tongue furnished with papillæ, at the base of which are attached two horny processes pointing forwards, which are intended to prevent the food passing into the fauces before it has been sufficiently masticated.

This Animal has lately been mentioned in the work of Mr. Cunningham, who appears to have been a very close observer of what he saw in New South Wales.—He says——

" I cannot omit to notice likewise *the Ornithorynchus*, that remarkable animal which forms the link between the bird and the beast, having a bill like a Duck and paws webbed similar to that bird, but legs and body like those of a quadruped, covered with thick coarse hair, with a broad tail to steer by.—It abounds in our rivers, and may be seen bobbing to the top every now and then to breath like a Seal, then diving again in quest of its prey. It is believed to lay eggs, as a nest with eggs in it of a peculiar appearance, was some time ago found. It bears a claw in the inside of its foot, having a tube therein through which it omits a poisonous fluid into the wound which the claw inflicts; and when assailed, it strikes its paws together and fastens upon his enemy like a crab."*

In closing my account of the above quadruped, I may be permitted to remark, that its peculiar conformation illustrates in a very striking manner (what may be equally applied to the Ourang Outang in reference to the human species, to the Bat as partaking of the qualities of the bird, and in a comparative degree, to created things in general,) that nature, while she preserves a chain of affinities or resemblances throughout all her works, has given to each portion, such an identity of character and laws, that no interference can possibly occur; and thus, under a multiplicity of operations apparently opposed to each other in their nature and effects, one general consequence is the result, and by this, the harmony of the whole is uninterruptedly preserved.

Every part of the animal kingdom indeed presents so extensive a scope for the contemplation of the Philosopher, and when closely examined,

* In confirmation of Mr. Cunningham's account of the poisonous claw of this animal; I have since received, in a communication from a near relative in the Commissariate Department, at Van Dieman's Land, who states, that the spur to which Mr. Cunningham alludes has, upon examination, been found to contain poison; and that very lately the hand of a boatman, who having caught one of the animals alive, had been struck by the spur, became instantly and alarmingly swelled up the whole arm, and was long in recovering the effects.

will be found to be made up of so many interesting materials, that I cannot sufficiently impress upon your minds the importance of its study; not merely for the sake of acquiring a knowledge of the artificial divisions or classification of its several parts, or the external form of animals; (subordinate subjects which are in some degree necessary to be understood to enable you to make the proper distinctions) but for the purpose of investigating most minutely, the structure and economy of each animal in whose formation the most consummate wisdom and contrivance has been displayed; their relative operations upon each other; and the important part, each in its respective sphere has to perform, to fulfil the useful purposes, for which, like ourselves, they were first called into existence.

In my next lecture, I shall do myself the honour of submitting to you, my conclusive outline of the Mammiferous Quadrupeds, as arranged by Linnæus, with an account of the Whale Tribes.

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LECTURE VIII.

ON THE MAMMIFEROUS ANIMALS.

HAVING in the Lecture which I last had the honor of delivering to you explained, that the Mammiferous Quadrupeds are those Land Animals which uniformly give suck to their young; that they live principally upon the productions of the earth, and approach the nearest to the human species in their structure, habits, and intelligence; and having treated on the two first orders of Linnæus, which he has denominated, *Primates* and *Bruta;* the third division becomes the next for consideration.

The animals belonging to this order, are distinguished, by having mostly in each jaw, six conical, sharp pointed, front teeth; with, on each side of these, solitary projecting tusks, or canine teeth; and a varying number of grinders, also terminating in conical, or pointed processes.— Their feet are divided into toes, armed with sharp, hooked claws, and these, with their teeth, are their principal means of defence.—They live chiefly upon the carcases of other animals, no part of the earth being without some of their species; and as they are mostly wild and ferocious, Linnæus has given to this order, the appellation of *Feræ*.

It consists of ten Genera: namely, *the Seal Tribes; the Dog Genus*, (embracing the domestic Dog, the Hyæna, the Jackal, the Wolf, the Fox, and the Zerdoa, a very small, and beautiful animal, peculiar to Arabia.) *The Cat Tribes*, (in which are included the domestic Cat, the Lion, the Tyger in all its varieties, and the several species of Wild Cats.) *The Weasel Tribes; the Otter; the Bear; the Mole; the Shrew; the Hedgehog*; and *the Opossum Tribes*, including the Kangaroo.

In reviewing the animals attached to this order, though we find a few of them perfectly inoffensive, and others, which, by domestication, may be rendered the close associates of Man; yet generally, they are the most destructive to his person, or to his property, of any which belong to the animal kingdom; requiring his utmost ingenuity and best energies, to counteract their mischievous propensities.

But this circumstance, had no other presented itself, affords a proof of their utility; since Man being formed of capabilities only, which, without exercise, would have been of no avail to him; he requires to be placed in situations, and to be exposed to trials, which will call into play those powers that are to stamp his character in the creation; and in no instance perhaps do he stand more in need of his talents, than when assailed by enemies, with whose physical qualities he cannot compete, and whose object, is cruel destruction, without one hope of mercy, or forbearance.—To make up therefore for his physical defects, he must have recourse to invention, or to deep laid stratagem, or in other words what he cannot effect by his natural powers, he must accomplish by his ingenuity, or by the force of his contrivance.

Having thus repulsed the first attacks of his enemies, he is led by cultivation to destroy his haunts; and thence from post to post to drive him to his last resource, the wilderness or the desart, rarely to disturb his future occupations.

The ferocious animals therefore, by exciting the human intellect, and by awakening Man's attention to the means of defence and attack, which probably led to some of the earliest of his inventions, have laid the foundation for those improvements in the arts, in which we now find them; and thus have *indirectly* proved the source of the greatest utility to Man. While, by furnishing him with furs and other parts of their bodies, such animals have *directly* been the means of promoting that extensive commerce, upon the success of which, his wealth, and his importance so mainly depend.

Thus the closer we examine the plans of providence, the greater reason have we to be convinced, that in no instance has an evil occured, without its being more than compensated, by some preponderating good. In confirmation of the great effect of civilization, and of the improved state of the arts, in contributing to the destruction of the more offensive animals, we may adduce the present state of many portions of Europe, which, in former times, only served as shelter to Bears and other large carnivorous animals; but which, now, are covered with domestic herds and flocks, or are engaged in extensive cultivation for their support; while in this country in particular, which, not a very long period back was overwhelmed with Wolves and Foxes; the former animals have been completely extirpated, and the latter so diminished in numbers, that we may look forward at no very distant era, for their total extinction.

In The Tropical and Polar Latiudes, the inhabitants have still to contend with ferocious animals; but these by, improved cultivation, have been so generally confined to swampy desarts and to the remotest forests, and by an advancing population, are in the way of being still further restricted; that their depredations, it is reasonably to be conjectured, will in a few years cease to be formidable.

If we look back to the Antidiluvian state of the globe, Geology informs us, that the face of it must have been over rún with a much greater number of wild animals, and many of a still more ferocious character, than those which have inhabited it since the era of the deluge; as not only vast collections of the remains of the offensive and other animals of Tropical and Polar Latitudes (as the Tiger, the Hyæna, the Bear, the Crocodile, the Elephant, the Rhinoceros, the Hippopotamus, and many of a smaller species,) have been found in various caves of the temperate portions of Europe, and in this country in particular, as so ably illustrated by professor Buckland; but fossil specimens of immense Carnivorous animals intermixed with those of the ruminating order, have been discovered in the various strata of the different portions of Europe, and America, of which we have no living specimens at the present day.

This would lead us to conjecture, that the deluge, like other great visitations, has been productive to the subsequent race of mankind, of some very permanent good; not only by limiting the numbers of the more ferocious animals, but probably also, by rendering the vegetable and mineral kingdoms, more accessible and suitable to Man, under that progressive state of civiliation, which, from our present experience we find he was destined to reach.

In examining some of the living animals belonging to the order of *Feræ*, and those the most dangerous to the human person, we cannot but be struck with the beauty and proportions which nature has bestowed on their external form ; and how often in the more useful animals, as in the Elephant, the Camel, the Ass, and the like, she has given an unseemly exterior.—For in what animal do we see, so dignified a countenance, so noble a mane and chest, and limbs so powerful and well proportioned, as in the Lion? or where do we find a skin so beautifully variegated, covering a body and frame so vigorous and overwhelming, as in the Tiger; who by one single stroke of his foot, can beat to the ground an animal larger than himself, and by one bound can make a leap, equal to the swiftest of the animal species? and if we descend to animals of the smaller tribes, we have the Panther, the Leopard, and the Tiger Cat, as specimens of beauty, rarely to be equalled by any other portion of the quadruped race.—For though among our domestic animals, as the Dog, the Horse, and some of the Goat and Deer species, we find many causes in their figure for our admiration ; yet these bear no proportion in those external marks of beauty, by which the animals above alluded to, are to be distinguished.

But this ornamental exterior, intended no doubt for some useful purposes in nature, which, under our present limited comprehension, we cannot explain, proves to these animals, their greatest bane; since they form the great inducement for our own species, even at the risk of their lives, to destroy them for the sake of their skins; thus appearing to justify the observation, that might be equally applied to our own kind; namely, that exterior beauty alone will rarely command lasting protection and countenance, when the other still more essential good qualities are wanting.

As these are few of the animals upon which I have just been treating, that have not been rendered familiar to you by personal observation, or from popular description, I shall call your particular attention only to *the Kangaroo*, whose history has been rendered interesting from the peculiarity of its structure, and from its having been seen in no other country but New South Wales and its dependencies; but whose physical character and propensities are so directly at variance with most of the other animals which Linnæus has placed in this order, that Cuvier has, with more propriety, attached it to his division of *Marsupiata*, or animals with pouches, to which also belong the different varieties of *the Opossum*. But as the Opossum makes use of its extremities like other quadrupeds, and the Kangaroo, from the shortness of its fore legs, moves principally on its hind feet by bounds and leaps; the latter is obviously entitled to a distinct, and separate consideration.

The only quadruped which resembles the Kangaroo in the particular quality just alluded to, (if we except *the Kangaroo Rat*, also confined to New South Wales, and which may be considered a dwarf variety of that animal,) is *the Jerboa*, a specimen of which is now presented to you.—But it wants the abdominal pouch to mark its near affinity to the Kangaroo, and is not an inhabitant of New South Wales, but of Egypt, East Barbary, and Arabia,

It is, as you will perceive, about the size of a young Rat, to which in its external conformation, (excepting in the disproportion of its legs from which it derives the quality of leaping on its hind feet, like the Kangaroo,) it bears no small resemblance; but contrary to the Rat, it is perfectly harmless, living entirely on fresh vegetables, and, like the Rabbit, forming burrows for its retreat.

The Kangaroo, now to be described, contrary to most of the other animals noted down by Linnæus in his order of Feræ, which it is well known live on raw flesh, and only accidentally congregate; is in every respect a gregarious animal, feeding entirely on grass and other vegetable substances. It was first noticed in the year 1770, in New South Wales by Sir Joseph Banks, when accompanying Captain Cooke in his voyage of discovery; and since, has been frequently found to exceed the size of a full grown sheep, and when standing on its hind feet in the act of leaping, to be equal in height to a middle sized man; measuring from the point of the nose, to the extremity of the tail, more than six feet, and weighing nearly one hundred and forty pounds.—Kangaroos, even larger than the above, have been killed in New South Wales; but those of the common size, may be estimated at two thirds less, and there are still smaller species to be met with in that country.

Upon our first view of this animal, whose color is of a mouse grey, we are immediately struck with the elegant, and tapering form of its head, neck, and shoulders, compared with the great bulk and muscular strength of the lower part of its body; with the diminutive length, and smallness of the fore legs, in proportion to those of the hind ones; with the very extraordinary strength of its tail; and with the peculiar arrangement of its teeth, having six incisors or front teeth in the upper jaw, the two middle ones being much larger and more pointed than the other four, and only two incisors, extremely large, long, and prominent, in the lower one; each jaw having ten grinders, without the canine teeth peculiar to the

Opossum, which, in every respect, may be considered a carnivorous animals.

But the most curious part of its mechanism, is the abdominal pouch of the female, in which is completed the formation of its young, and which afterwards serves as a retreat for it, until it finally quits its parent.

This bag is produced by a folding or doubling of the common integuments at the lower part of the abdomen, so as to form an open pouch which admits of the offspring passing out, and returning at pleasure; and this outlet by the agency of internal muscles, can, at the will of the animal, be so firmly closed, as hardly to be perceptible to the naked eye, and then not to be opened, but by the greatest mechanical force.

Within this extra receptacle, the young of the Kangaroo, and of the Opossum tribes, are completed in their form, and are suckled; the former not quitting it, until it has reached the size of a small poodle Dog; and continuing to make use of it as a retreat, for a considerable period after it can help itself; jumping in and out with great great rapidity, as is the practice also of the young Opossums. Thus the young of the Kangaroo and of the Opossum tribes, are better secured against external injury, than those perhaps of any other animal; but why this deviation from that general rule which obtains in all other Quadrupeds, should be confined to those tribes, and which, with the exception of the American Opossums, and a few in the Indian Islands, are only to be met with in New South Wales and its dependencies, is a circumstance, we can as little comprehend, as we can explain many other very extraordinary phenomena, which, in the natural world, are so frequently presented to our observation.

The Kangaroo, unlike the Opossum, which often brings forth a very numerous offspring and accommodates the whole in her abdominal pouch, has rarely more than one at a time; and if we except the peculiar conformation which we have just explained, may be considered altogether a very different animal from the Opossum, though Linnæus has made it one of the species of that genus.

The motions of the Kangaroo also are very different from those of the Opossum, whose legs are formed, and used, the same as most other Quadrupeds; while the actions of the Kangaroo, excepting at the time of grazing, or of burrowing under ground to form its retreat and for which its sharp, hooked claws are well adapted, are always performed on its hind legs assisted by its powerful tail, which, acting as a lever, produces all the effect of an extra limb; and these together, enable it to take such broad and rapid leaps, that the fleetest grey hound can scarcely overtake it; making bounds of twenty feet, or more at a time, and with the greatest ease springing from rock to rock over bushes more than seven feet in height; and if finally thrown on its back, using its tail and all its sharp claws at once in its defence, and with an actvity and force, that never fail to painfully annoy its enemy, and sometimes fairly to drive him from the field.

The Kangaroo, however, is naturally a very inoffensive animal, feeding entirely on grass, and the smaller vegetable snbstances.—It is killed by the Natives, for the sake of its flesh, which is stated to be tender and well flavoured, and of its skin, which serves as their only clothing; many of them being without even this very simple resource.

Having lately had more than one opportunity of seeing three Kangaroos at their feeding time, I am enabled to speak with more confidence on their form and actions.—Upon the first approach to these animals, they were thrown into the awkward position of resting on all their legs to take their food; but upon my urging them with the point of my umbrella, they immediately assumed the erect attitude, by resting upon the whole length of their hind legs, and jumping in the manner, and with all the facility of the most active bird; thus confirming an observation made in my last lecture, viz. that in many instances, nature has given to animals, very opposite in their kind, certain external resemblances, without interfering with that general unity of character, by which each portion of the Creation, animate as well as inanimate, is so obviously to be distinguished.

The animals belonging to *the fourth order* of Linnæus, are known by their having two remarkably large, long, and chisel-shaped front teeth in each jaw, and no canine teeth; by their legs being formed for running and bounding; and by their feet being armed with claws for scratching. They live principally upon the roots, bark, and other parts of vegetable substances, a few only eating animal food; and as their operations are carried on principally during the night, and as they sleep much in the day, this order has been denominated *Glires*, from Glis, the Dormouse, though Cuvier has more correctly classed them in his division of *Rodentia*, or gnawing animals.

This order consists of eight genera, namely, *the Porcupine; the Hare*, including the Rabbit; *the Castor or Beaver; the Rat*, embracing the common Mouse, and the Dormouse; *the Guinea Pig; the Marmot; the Jerboa*, previously described; and *the Hydrax*, a Cape animal resembling the Marmot.

All the animals in this order, from their wild and predatory habits, from their feeding on the most useful vegetable substances, and from their propensity to gnaw every obstacle that stands in their way, are more or less destructive to human property. But there are three of the species, namely, the Beaver, the Hare, and the Rabbit, which directly admit of practical uses; while most of the others are employed as food by the uncivilized inhabitants of the countries in which they prevail, and with these people, their skins also are often brought into use.

Among the animals classed by Linnæus, in his order of Glires, *the Beaver*, from the peculiarity of its instincts and habits, is in every particular deserving of historical notice, and therefore I shall confine my observations to this animal.

The Castor Fiber, or Beaver, is rather larger than the Badger, measuring about three feet in length, from the tip of the nose to the tail, and weighing from fifty to sixty pounds. It is an inhabitant of the northern parts of Europe, Asia, and America, but particularly of Canada, where it is to be found in the woody banks of rivers and unfrequented lakes, feeding on the bark and leaves of trees peculiar to those situations, avoiding animal food of every kind; though it has been stated by some authors, that it partakes of cray fish; a circumstance, considering its usual propensities and the formation of its teeth, very much to be doubted.

Its outline presents a head, thick and pyramidal, with small, circular eyes, short ears almost concealed in its fur, and a blunt nose—a thick and short neck—and a very strong, compact body, highly arched in the back, terminating in a tail about a foot in length, partly enveloped in fur, and partly encased in close and compact scales, adjusted like those of the fish, and which, convex above, and broad and flat below, is particularly suited to the purposes for which this instrument seems to have been intended; namely, as a paddle and rudder to forward and regulate the animal's motion when swimming; and as a trowel to press together, and afterwards to plaster the materials, which it uses for the erection of its habitation.

Its fore feet, which resemble in shape those of the Rat, are small and short; having five divided toes, strongly armed with claws, well calculated for digging the holes into which are to be deposited the foundation of its building; and these feet, like the Squirrel, it also uses as hands to convey substances to its mouth, or to assist in removing them from one place to another, when it is in the act of collecting its materials.

Its hind feet are made large and powerful with five toes connected like those of the Goose by a strong membrane or web, which affords to the animal that facility in swimming that forms so peculiar a part of its habits. It is owing to this difference in the structure of the fore and hind legs, that the Beaver swims better than it can walk; the latter action consisting of a shuffling kind of motion, which throws its head low, and very considerably increases the arch of the back.

Its head, the whole of the body, and a part of its tail, are covered with a double fur; the one next to the skin and of which our hats are manufactured, being a soft, downy substance, well calculated to act against the severe cold by which the Winters in Northerly latitudes are to be distinguished; while the exterior coat is formed of long, strait, and coarse hair, of a dark chesnut colour, approaching to black; in somê, of a deep black; in afew, of a milk white; more rarely of a cream color; and sometimes, of patches of black spots upon a white ground.—This coat, while it adds, to the warmth of the animal, seems intended, like the feathers of aquatic Birds, to throw of the water from its several points, while the Beaver is in the act of swimming, and thus to preserve the skin from the influence of the wet, to which, from the habits of the animal, it would otherwise be constantly exposed.

The under Fur, from its universal application in the manufacture of hats, it is well known, forms a very important and leading article of commerce; and it is for this, and to obtain an useful article in medicine, named *Castor*, which is procured from glands situated at the lower part of the animal's abdomen, that the Beaver is hunted and destroyed for European purposes; while the natives kill it for the sake of its flesh, which they eat, and of its skin, which they use as an article of clothing.

But one of the most interesting parts of its structure, is the teeth; by the agency of which, so many important operations of this animal, are to be performed.

These, like the other animals of the same order, consist only of molars or cheek teeth, and incisors or cutting Teeth, between which, from the absence of the Canines, there is necessarily a blank space.—The molars, which are eight in each jaw, have their sutures deeply divided by small ridges, which increase their capability of grinding the hard substances, as wood, the bark of trees, and the like, which constitute the Beaver's food; and ofgrasping them firmly when conveying them from one place to another; while the incisors, two above, and the same below, are of a prismatic shape, running out long and strong into a sharp, chisel formed edge, by which the animal is enabled with wonderful rapidity and effect, to gnaw through and divide those trees and their branches used, as before stated, for their food and as one of the chief materials of their buildings; and as these teeth, by constant detrition, are liable to wear out, nature has provided them with a renovating power, by which the supply of new matter keeps pace with the exhaustion ofthat already in use.

I should not have engrossed so much of your attention in detailing the structure of this animal, had it not been so closely interwoven with actions, that have rendered the Beaver, in the estimation of some naturalists, the most intellectual of the mammiferous Quadrupeds, and even almost contending with Man, in those inventive qualities, which have ever been considered as one of his most distinguished attributes.

After the complete distribution of the several members of their society, during the spring and early summer months, into the recesses of the Forest; to reassemble them in colonial order at the commencement of Autumn, upon the banks of some river, or lake, there to determine in what part of the water they shall fix their winter abode; to assign to a certain number of each sex, the part they shall have to perform in the completion of their object; to build a dam across the stream when a river is decided upon, by means of stakes and earthy materials, so placed as to stop the current of the water, in order that it shall always retain are equal elevation in those parts where their houses are to be erected; to cut down trees with their teeth, and convert them into stakes which, by burrowing holes with their fore feet they shall afterwards fix upright in the water in double rows to serve as pillars for their future edifices; to slip off and pare the branches of those trees and interwove them between the uprights so as to form receptacles for the earth and other materials brought thither by their mouths and feet for the erection of those buildings; and to press the materials down with their feet and tail so effectually, that not the least particle of air or water can penetrate, and so strong and durable, that only by the application of the greatest force they can be destroyed; to give to their habitations floors, roofs, and separate apartments for their winter stores and for sleeping, and to plaster them over with all the nicety and effect of the most expert mason, and to live harmoniously in considerable numbers of both sexes in one chamber, as interestingly detailed in Buffon's Natural History, and confirmed by the most authentic testimonies which local experience can afford ; are certainly most wonderful circumstances, and such as strikingly to illustrate the diversified means by which the Creation is regulated, so as to preserve a due unity,and yet each performing a distinct and separate part.

But however such phenomena may excite our warmest admiration, as proofs of the care which has been bestowed on each portion of the Natural World; yet when we come to reflect, that the Beaver, so ingenious, and so provident in this particular instance, when brought to the test of domestication, (for it is susceptible of being rendered completely tame,) has proved totally incapable of being instructed in any other operations beyond those we have detailed, and certainly much less so, than many other animals under similar circumstances; we can only consider its actions as a perfection of instincts which are necessary to the preservation of the animal under all the contingencies to which it is exposed; and not in the least degree connected with reason, whose attributes are not confined to the accomplishment of one particular object, as in the Beaver, nor to any specific mode of performance; and it is to this circumstance that we may attribute the difference between human, and natural architecture. The one as liable to a fluctuating judgment, however diversified by a variety of plans so as to answer very multiplied purposes, is often deficient in some of its most essential parts.—While the other, depending upon fixed and invariable laws, is always perfect, and calculated to produce the desired effect even in the minutest particular; but is uniformly limited to one object, from which it in no instance deviates.

But the wonderfully instinctive powers so obviously displayed in the Beaver, are not confined to that animal; since the Bee, the Spider, the Ant, and we have no doubt, many other animals, could their economy be as nicely ascertained, would be found to possess inventive faculties as comprehensive, and terminating in results equally explanatory of the contrivance. and order by which the natural world has been regulated, as the animal under consideration.

In *the fifth order* of Linnæus, all the ruminating animals are included; and as among these the Sheep forms the most numerons tribe, this order has been denominated *Pecora.* It is distinguished by the animals having no front teeth in their upper jaw, though from eight to ten in the under; and with a varying number of grinders, by their being without canine teeth, the absence of incisors in their upper jaw, obliging them to use their tongue as an auxiliary when feeding; by most of the animals having norns, or, in their absence, projecting tusks for their natural defence; by their feet being protected by cloven hoofs; by the second mastication or rumination of their food, and by their requiring four stomachs, and a very long intestinal canal for its digestion and final conversion into the proper nutriment.

This order consists of eight genera; namely, *the Ox species; the Sheep; the Goat; the Stag; the Antelope; the Giraffa or Cameleopard; the Musk, and the Camel.*

Of these I shall confine my particular observations to the four last, and conclude my notice of this order, by a few general remarks on the utility of the preceding ones.

The Common Antelope is an intermediate animal, between the Goat and the Deer; the form of its body agreeing with the latter while its horns partake of those of the Goat. It is somewhat smaller than the Fallow Deer, of a tawny, reddish brown colour above, and of a white beneath; with beautiful black horns distinguished by a double flexure, and by numerons prominent rings or circles throughout their whole length. It is altogethera most light, and elegant animal, inhabiting often in herds of two or three thousand, the hilly countries of the warmer latitudes of Asia, and Africa; where, like the Goat, it clambers up precipitous rocks to browse upon their scanty productions, or it feeds upon the tender shoots of trees peculiar to those regions; being active, restless, timid, and wonderfully swift; bounding from place to place with vast elasticity, and, when alarmed, making extraordinary leaps over precipices and gaps, or whatever may interrupt its progress; frequently stopping to watch its pursuers, and then, with increased energy, renewing its flight.—Next to the elegant form of its body and limbs the symmetry of which, nature has displayed its greatest taste, it is distinguished by those full and beautifully black eyes, that so often have formed the subject of romantic eulogium and simile in Eastern Poetry.

Among the varieties of the Antelope genus, *the Gnou*, which I lately had an opportunity of seeing alive in London, from its singular confirmation, has especially attracted the notice of naturalists.

This animal, to which the African name of *Gnou* has been given from its bellowing like an ox, is a native of the plains of Numagua, to the north of the Cape of Good Hope, and by some naturalists has been classed with the Goat.—It forms a strange mixture of other animals, the head resembling the ox; the body, mane, and tail, the Horse; the legs, the Stag; the lachrymal sinus, the Antelope; and the horns, the Goat. It is rather below the size of a common Galloway, its general colour being of a dark brown, with the exception of the tail and mane, which are of a light grey; and of the shagg on the chin and breast, and the stiff hairs that stand erect on the forehead and upper part of the face, which are all black.

The head is very large, thick, and clumsy, like that of the ox; with a square mouth, and broad flaps over the nostrils, and short stiff hairs on both lips; those on the under lip, being intermixed with long bristles.—Over the nose, there is a long, stiff brush of black hair; and upon the chin, throat, and chest, extending between the fore legs, a hanging beard or brush of wh te hair, which gives a peculiar character to the animal's external aspect.—Upon the neck, which is short, thick, and somewhat arched, we observe a strong, erect and ash colored mane, and this, with the tail, which is long, white and flowing, resembles that of the Horse.—Its horns which are black, strong and scabrous, take a very peculiar direction, as you will perceive by the specimen presented to you, and in their structure approach the nearest to those of the Goat.

The body, as previously observed, bears resemblance to a well formed horse; its long, elegant, and slender legs, to that of the Stag, the half formed spurious hoof on each foot, being peculiar to itself; while the orbits of the eyes, approximate the nearest to the Antelope.

The Gnou feeds in large herds on the African plains, where it fiercely and furiously defends itself against its adversaries with its very powerful horns, which serves an instrument of great defence.

We have here another very striking proof of some portion of the external form peculiar to different animals being united in one species, without interfering with the particular laws and habits by which each is governed; thus displaying the variety in which nature loves to indulge, without losing sight of those fixed and determinate rules, by which her operations are generally governed.

The *Giraffa*, or *Camelcopard*, is an African Animal of very singular appearance; the neck being remarkably long in proportion to the body, which, covered with a beautiful spotted skin not unlike that of the Panther, slopes back so mnch as to give a still greater prominence to the neck, and to render the animal, when the neck and head are erect, more than eighteen feet in height, and thus the tallest of the Quadruped race.

Its head bears a considerable resemblance to that of the Horse, excepting that it is furnished with erect horns about six inches in length, which, from being never cast, may be considered permanent.—These horns are unbranched, and covered with a hairy skin, terminating in a tuft of short bristles.

Its neck, which is adorned with a short mane, is peculiarly long, slender, and elegant, giving to the Animal a most graceful appearance.—Its fore and hind legs, are nearly of equal length; but its shoulders are so prominent, that, throwing the back off in a descending arch, they convey to the mind a greater idea of elevation in the fore legs and neck, than they actually possess, particularly when the animal is reaching at substances igh-er than itself.

The Cameleopard is naturally a gentle and timid animal, confining its haunts to the interior forests of the warmer latitudes of Africa, where it browses on the leaves and smaller branches of trees, particularly of the mimosa or gum arabic tree, and to which the great length and form of its neck, admirably adapt it.

When taken young, (for the adult animal is rarely caught,) it is very easily tamed and domesticated, readily associating with any other animals that may be grazing in the same pasture with itself; as may have been observed in His Majesty's Park at Windsor, where one of this description was placed; but which, lately, has fallen a sacrifice to the lower temperature of our climate.

The Musk, is an inhabitant of the higher mountains of Thibet, and of the barren and snowy Regions of Central Asia. It resembles in size and general appearance, the Roebuck; but it differs from it, as well as from all the ruminating animals, excepting the Camel tribes, in having no horns; and from the Camel also, in being furnished with long, sharp, crooked tusks one on each side, pointing directly downwards and projecting nearly two inches beyond the lip, which are used for hooking up roots, and as an instrument of defence; and in possessing in the middle part of the abdomen, a sac about the size of an egg, that supplies the musk of the shops, which, when fresh from the sac, is stated to be so excessively penetrating, as to force blood from the nose, eyes, and ears, of those who incautiously smell it.

This well known remedy and perfume, when taken from the musk, is deposited in small bladders, and sent to Europe; where, from the difficulty of obtaining the animal, it was at first sold for the exorbitant price of a guinea an ounce; but of late years, in consequence of musk being much less used than formerly, it is fallen very considerably in value.

The Pygmy Musk, is a very elegant little quadruped, about the size of a small cat, and is an inhabitant of Java and Sumatra, and so delicate in constitution, as to be incapable of being brought alive to Europe. It is distinguished by very minute legs and hoofs, the former, not exceeding a quill in diameter; by posssessing only very doubtful tusks, if any at all; and by not having, like the Thibet musk, a sac to furnish the perfume from which it derives its name, which has led some naturalists to consider it only a variety of the Antelope.

We come now to the history of an animal which, from the peculiarity of its structure, and from the important uses to which it is applied, is well deserving of your particular notice. I allude to *the Camel*, one of the chief domestic animals of Arabia and of Northern Africa, and where, from being the only channel of conveyance over the vast seas of sand and desolation peculiar to those countries, and from the local difficulties it has to overcome in the accomplishment of its journey, it has emphatically been denominated by the natives, *the Ship of the Desart.*

Previously however to our account of this animal, it may be proper to remark, that in the genus to which the Camel belongs, there are in all seven species; but of these only two may be considered as properly constituting what is familiarly understood by the term, Camel; and these are the *Bactrian Camel*, with two hunches on its back, which is peculiar to Central Asia; and *the Ara-*

bian Camel, with only one hunch, which is to be found in Persia, Egypt, and more generally in Arabia, the Barbary States, and beyond the great African Desarts, as far as Nigritia.

It is to the Arabian Camel with which my experience in Africa has rendered me the most familiar, that I wish to invite your attention, more particularly as it is this animal which is the most comprehensively used, and the best calculated to overcome the local difficulties, peculiar to the countries in which it is to be found.

This most useful animal, which has been improperly denominated by Linnæus, the Dromedary, (a term applied by the Natives to a swifter species of Camel,) like the Elephant, is not calculated, at first sight, to make a pleasing impression on the mind of the stranger.

A small head with short ears, and dull, heavy eyes, united by a long and very arched neck to a coarsely formed body, with a large hunch in the middle of the back; a tail with a full bush of hair at its extremity, hanging most ungracefully to the first joint of the hind legs; straight and disproportioned legs terminating in clumsy looking feet; and a slow, but long striding pace, in which the head is thrown most awkwardly prominent; are all circumstances peculiarly unfavourable to the external appearance of this animal

But, upon a nearer examination we shall find, that each of these parts, so unprepossessing in their aspect, has its own especial use in enabling the animal to perform those respective functions, for which it was most obviously created.—For the small head and ears, and the length and varying form of the neck, are particularly fitted to penetrate, without injury, the prickly trees and shrubs upon whose branches it is often compelled to feed; and these, combined with the structure of its teeth, which partly partake of those of the horse, and partly of the other ruminating animals, enable it to seize and masticate substances, which the latter could neither reach, nor swallow.

The hunch on the back serves as a protection to the rider who sits behind it, and to fix upon it with more steadiness, those heavy articles which it is intended to carry.—The bushy extremity of a powerful tail, is successfully used in driving off from its flanks, the offensive insects that swarm in the countries over which it has to pass; while the length and direction of its legs, and the peculiarity in the formation of its feet, consisting of two elongated toes, protected above, by strong nails, and below, by a thick, horny, but elastic pad, altogether give it that stability on the ground, and that adaptation of its feet to the soil, which are most essential to a beast of burden, used in conveying very heavy and cumbersome weights, over deep sands, in which every other animal would fail in the attempt.

But the most curious provision in the Camel, is in its being furnished, contrary to the other ruminating animals, with a fifth stomach, by which it is enabled to retain a large proportion of water for future use upon those emergencies, when a scarcity of that most essential fluid, forms one of the leading incidents of an African Journey over the Desart.

This consists of a series of cellular bags, often amounting to thirty, which are formed between the first and second stomachs, each capable of containing a certain quantity of water, which, by muscular action, can be regurgitated at the pleasure of the animal, so as for several days together to relieve the mouth and throat from that intense thirst, which the climate and fatigues of the journey never fail to create; and this confers on the Camel an additional means of performing journies, which other animals could not undergo, without almost a certain prospect of their destruction.

Thus, in investigating the works of nature, we are not to allow the imagination to supercede our deeper judgment; since there is not the minutest portion of an animal, or even of a vegetable, however unaccountable it may appear to us at first sight, that will not upon a closer examination, be found to have a most useful tendency; and convince us, that the gratification of the eye, however no doubt partly intended to harmonize the human mind to the surrounding objects; has been but of secondary consideration, in the views of providence, when a much more important end was to be answered.

The general utility of the Camel is too well understood to stand in need of a copious illustration.—It is obviously an animal of vast importance in the countries in which it is a native, where civilization has not led to the use of land carriages, and more especially, where the nature of the soil is unfavourable to their application.

The great desarts of Arabia and of Africa, where unbounded desolation marks their trackless surface, would never have been traversed without the aid of this most useful animal; which, at the slightest signal, docily bending his knee to the ground to receive on his back a load often exceeding six hundred weight, by the single guidance of a rope fixed to its nose, it proceeds with measured steps over those regions of sand and sterility, where no other beast of burden can find a hold; and whose scanty vegetation and arid surface, exclude the hope of supplies to less hardy animals.

Endued, as we have previously stated, by means of a cellular stomach, with the power of retaining a large proportion of water, and afterwards, by muscular action, of regurgitating it as it stands in need; and laying in an ample supply of provisions in another stomach, which, by subsequent rumination serves to diminish the degree of hunger to which other animals would be exposed; it seems formed by nature for the especial duties which human conveniencies have assigned to it; affording one of those numerous instances, in which Providence has so benevolently adapted its operations to the necessities of the occasion; and where the deficiencies on the one hand, have been most amply compensated by a proportionate accommodation in the other.

In all those parts of Turkey, Persia, Arabia, Egypt, and Barbary, where land carriages would be of little avail, the whole commerce is conducted by means of Camels; and thus, as in the Elephant, communications the most important have been preserved between places, to which mankind, otherwise, would never have had success; while population has been introduced into regions, which, without the aid of this most invaluable animal, would have been left to the remorseless tiger, or to the still more wary, (though not less destructive) serpent.

The Arab of the desart, in a few instances the faithful guide of the uninstructed traveller, though too often his most treacherous foe, by means of the accommodating Camel, finds a residence in the dreary desarts of Africa and Asia, where, from the unkindness of the soil and climate, no other human being dare to fix his abode; and from that animal he derives his habitation, his food, his clothing, and in many instances, his medicine.—From the hair of the Camel, his tents and dresses are manufactured; from the skin, his leather; from his flesh and milk is furnished a nutritive, and wholesome repast; and from his manure, he obtains his remedies; and when desperately pressed for water, by destroying the animal, he finds a most ample resource in the cells of his stomach.

Of the usefulness of our own dosmestic animals of the ruminating class, a very few observations will suffice; since their importance is familiarly brought home to our feelings and conviction, as forming the great source from which most of our comforts, and some of our principal luxuries, are procured.

In illustration, we need only mention the Ox species and the Sheep (not to say the Goat and the Stag,) to bring to your recollection how comprehensively those animals are called into utility, throughout every part of the world where civilization has marked the steps of man.

From these animals, as applicable to our immediate necessities, it is well known, we derive our principal articles of food and clothing; and through one of them, (the Ox,) a very considerable auxiliary to the labours of the field. From various parts of their bodies, we also are furnished with those sources of barter and commerce, our butter, our cheese, our tallow, our wool, and our hides, which not only supply us with our immediate necessities, and obtain for us in return foreign commodities to an amount, highly favourable to individual wealth and to national prosperity; but also through the medium of that commerce, we have acquired a knowledge of countries and their resources, of which, few other nations have hitherto been susceptible.

For the support of animals, so universally applicable to human wants and conveniencies, agriculture in all its comprehensiveness, has, in this favoured country at least, been brought into its fullest activity; and from the virtuous occupations and manly pursuits to which it has given rise, and from the interest it excites in the soil to which we are attached; it blends in its operations and consequences, not only vast national importance, but some of the best feelings and noblest propensities of our nature.—A genuine love of our country and of its invaluable institutions, and a laudable emulation to improve its resources; an affectionate attachment to our friends and connections, and a benevolent disposition towards our species in general; and lastly, (though not the least in our estimation,) a kind and protecting humanity to those useful animals, through which we principally derive every blessing which agriculture, and a soil that is congenial, can bestow.

In *the sixth order* of Linnæus, and the last of the Mammiferous Quadrupeds, the animals are distinguished by obtuse front teeth, and by hoofed feet, and as they are bulky and heavy, this order has been denominated *Belluæ*.

It consists only of four genera, *the Hippopotamus*, *the Tapir*, *the Hog*, and the *Horse;* animals as opposed to each other in their formation and character, as could well have been brought together.

Thus the Hog, inferior both in form and inteligence, has been placed upon a footing with the Horse, one of the noblest of the Quadruped race; while both those animals, so useful in their respective ways for domestic purposes, have been ranked with the Hippopotamus and the Tapir, which are altogether remote from observation, and in their habits and propensities, the most destructive to human property. As the latter animals however are singular in their form and haunts, a brief account of each, may not prove uninteresting.

If the Elephant and the Camel, present to the eye an unpleasing exterior, the *Hippopotamus*, or *River Horse*, with none of the good qualities by which the two former animals are to be distinguished, is a far more disgusting object.

Its head is of an enormous size, which is rendered the more striking, from the diminutive proportion of its eyes, ears, and nostrils, from the great magnitude of its mouth, which, when wide open, has measured two feet in circumference, and from the extraordinary and irregular distribution of its teeth, amounting in all to 40 and giving to this part of its frame alone, an aspect peculiarly disgusting.

In reverting to its teeth, we find, in the upper jaw, four incisors in separate pairs and distinct from the other teeth, and the same in the under, the intermediate ones being the longest; and two canine teeth or tusks in each jaw, in form prismatic, sharp, and crooked standing solitary and projecting, and of so hard a texture, that they will strike fire with flint, but whose Ivory is so beautifully fine and white, that it is often prefered to that of the Elephant, more especially for artificial teeth.—These tusks have been known to measure 32 inches in length. The grinders, of which a specimen is on the table, are also so large, that a single tooth has been known to weigh three pounds.

Its body, which is only very scantily covered with white hair, is immensely bulky, being scarcely less than that of the Elephant, and weighing in some instances more than 3000 pounds; and though placed upon very short legs, the height of the animal from the arch of the back to the ground, has been known to exceed seven feet.

Its legs are short, thick, and clumsy, with feet broad, and hoofed on the edges; the hoofs being divided into four parts, or toes. Its tail, which is about a foot long, is taper, compressed, and naked and not unlike that of the Hog. Its skin, which is of a dusky color, is remarkably thick and strong, and so resisting, that the largest musket ball can hardly penetrate it.

With such a prodigious strength of body, the Hippopotamus ought to be a match for every other animal; since its bulk has been found so great, that after being killed in the water, it has required twelve Oxen to draw it in shore; yet it is naturally so timid, that it makes no attack until it has been wounded, and then it furiously assaults the boats sent in pursuit of it, and will often sink them by biting large pieces out of their sides.

It is an inhabitant of the Rivers in the interior parts of Africa from the Niger to the Bengal River, many miles to the North of the Cape of Good Hope, and in those streams it delights to live; * leaving the water only during the night in search of pasturage in which it consumes great quantities of Sugar Canes, Rice, Millett, and other vegetable productions; feeding also upon the roots of trees, which it loosens up with its great tusks, and thus doing altogether great damage in cultivated countries, but avoiding animal food of every kind.—When alarmed, it retires rapidly to the river, where it sinks to,

* It has also been found in the Nile in upper Egypt, and in the fens and lakes of Ethiopia contiguous to that River.

and walks at the bottom with the greatest ease, only rising to the surface for a fresh supply of air; and though it is not provided like the Beaver, with membranes between its toes, yet the buoyancy of its body, enables it to swim with great facility.

In the countries which it inhabits, its flesh is considered by the Natives, a great luxury. Its skin is made into whips, shields, and the like; and its tusks are sold as Ivory, which, as before stated, is considered to be finer and superior for many purposes, than that of the Elephant. So that this animal so disgusting in its exterior aspect and so remote and so peculiar in its haunts and habits, is found out, and rendered subservient to human purposes; thus confirming a former observation, that the more we examine the works of nature, the more are we convinced of the obvious utility of which each portion of it is susceptible.

This animal which was well known to the Romans, has been noticed in several passages in scripture under the denomination of *the Behemoth*; but particularly in the 40th. Chapter of Job; where its manners, food, and haunts, have been well, but concisely described; and though in the living state, it has only been found in Africa, yet fossil remains of the Hippopotamus have been discovered in the South of France, in several parts of Italy, and lately at Brentford in this country, about thirty feet below the surface.*

" * The *Head of a Hippopotamus* has recently been brought

The Tapir, though differing in form and magnitude from the other animal, may be considered, from its haunts aud habits, the Hippopotamus of America, where it is to be met with in the woods and rivers of the Southern portion of that continent, from the Isthmus of Darien to the streams of the Amazon.

This animal is about the size of a small Ox, and in its general conformation, is very similar to the Hog, excepting that the snout forms a proboscis far beyond the lower jaw, which, like that of the Elephant, can be contracted or extended at pleasure; while the back is rather more arched, and the legs shorter, in proportion to the size of the body

Like the Hippopotamus, it exceeds in the number of its teeth, most other quadrupeds, having ten incisors, ten grinders, and two canine teeth in each jaw, making in all forty-two.

to England, with all the flesh about it, in a high state of preservation. This Amphibious Animal was harpooned while in combat with a Crocodile in a lake in the interior of Africa.—The head measures near four feet long, and eight feet in circumference; the jaws open two feet wide, and the cutting teeth of which it has four in each jaw, are above a foot long, and four inches in circumference. This formidable and terrific creature, when full grown, measures about 17 feet long from the extremity of the snout to the insertion of the tail, about 16 feet in circumference round the body, and stands above 7 feet high. It runs with astonishing swiftness for its great bulk, at the bottom of lakes and rivers, but not with as much ease on land. The head is intended as a present to His Majesty."

See Magazine of Natural History, Volume 1.—*Page* 288.

An animal resembling the Tapir has been noticed in some of the Islands of the Indian Ocean, but not so frequently as exactly to determine how far it is to be considered a variety of the same species. This animal was seen and has been described by Sir Stamford Raffles.

The American Tapir is a mild and inoffensive animal, frequenting the woods and rivers as we have described, and like the Hippopotamus, feeding by night on grass, sugar canes, fruits, and the leaves of trees, and using its proboscis like the Elephant to seize and convey its food to its mouth.—If attacked, or alarmed, it flies to the water, swimming with great ease, and plunging to the bottom, where, like the Hippopotamus, it walks on the ground, until compelled to return to the surface for a supply of air; and if it cannot escape, it makes a most desperate resistance both against Men and Dogs.—Its flesh is eaten by the Natives, and by them its skin is converted into leather, and used for various other purposes; but it does not appear that its tusks, like those of the Hippopotamus, are called into any particular use.

The general character of the Hog and the Horse, is too well known, to need illustration in a lecture which may be considered altogether popular. But I cannot pass over the latter animal, without bearing testimony to the noble qualities with which he is endued, and to the varied and comprehensive applications of which he is susceptible.

For in what animal do we find such a combination of symmetry, strength and swiftness; so much sagacity, boldness and docility, as in the horse?

Endued with physical powers, which, called into full activity, few animals could encounter, and by no means deficient in apprehension, he allows himself to be guided by a child; and patiently and efficiently performs his duties, only requiring ordinary attention to attach him to the very person by whom he is most enslaved.

Without the horse, man would be deprived of one of his most useful resources, his dignity would be degraded, and his best energies be of little avail.—For what would become of our agriculture and our commerce, or how are we to defend ourselves against, or attack our enemies, without the aid of this noble animal?

To the horse we are not only indebted for those delightful recreations and conveniencies from which we derive our health and amusement, and that personal intercourse, without which, human affairs must stand still, and the charms of society lose their greatest zest; but also those invaluable communications with the remoter parts of the country, to which, so many useful considerations, public and private, are attached, many of which, were the horse to become extinct, would for ever be closed.

This noble animal therefore has an irresistible claim upon our protection and humanity; and consequently his exertions, so useful in all their varied applications, should never be wantonly abused, or ungratefully rewarded; nor should we forget that, without his aid, man would be far more helpless than the animal, to whose labours and toils, he is indebted for so many of the blessings which he now enjoys.

Having concluded my account of the Mammiferous Quadrupeds, allow me again to call your attention to the study of Natural History, in which those animals hold so conspicuous a place.

The eye is so uniformly familiarized with the surrounding objects of nature, and we intermix so much *of ourselves* in all our pursuits, that we too readily lose sight of those sublimer subjects, from the knowledge of which (to say nothing of their practical usefulness) not only valuable lessons are taught us, but also are to be derived some of the highest gratifications of which the human mind is susceptible.

It is well known that the attributes of the Deity, as exemplified in the works of the Creation, of the several parts of which Natural History alone can make us acquainted; have employed the pens of the wisest and best of our Philosophers; of which, the works of Ray, Derham, and

Paley, afford the most illustrious examples; while Men of the greatest genius have employed their time and their talents, in detailing the several portions of nature, with an accuracy and minuteness, which at once display their sense of the importance of this most interesting of studies.

But still, unless some accidental circumstance awaken our attention, or our minds have been directed to the subject, how often do we pass by, unnoticed, those wonderful Phenomena in nature, by which we are in every direction surrounded (for the Creation throughout is made up of wonders) and which ought to have been the first to engage our most anxious enquiry.

Thus the Mammiferous Quadrupeds, which hold the most important place in the natural world, next only to ourselves, we find, are made up of materials similar to our own; in their internal structure with some modifications, (of no importance in a general view) they are exactly the same; and their external form only, has been varied, because they have to perform mechanical actions, of which we, in our condition, do not stand in need. Their blood is of the same composition, temperature, and color, as our own; and is impelled by the same kind of organ, and circulates through similar channels; and the air, which is as necessary to preserve their lives, as ours, is called into action by an instrument as perfect as the one through which we breathe and have life; while like us also, they have been endued with a brain and nervous system, to make them sensible of the pleasures and pains, of the wants and gratifications, of the affections and dislikes, and to give an impulse to those multiplied actions, of which life, in our more perfect state, is so amply made up.

Like our species also, they live upon the productions of the earth, upon the surface of which, some of their varieties are to be met with in every portion which has been visited by man; and many of them imitate us so closely in our actions, or associate with us so readily, contribute so essentially to our conveniencies, or are thrown so immediately under our care and direction; that they appear to be only a subordinate part of the same family; and though a few, from their solitary and predatory propensities, have been placed beyond the pale of human protection, and are inimical to our species or to our property; yet even these, as we previously have had occasion to observe, are indirectly useful to us, by calling forth our energies to destroy them, or by the application of some parts of their bodies, which, our wants and our luxuries, have rendered it necessary we should possess.—And if from the superiority *of our intellectual capacities* they have been placed lower in the scale of animated beings, than ourselves; yet this has been amply compensated to them, by those innate or instinctive qualities, which, while by means the most wonderful, they contribute to their preservation and enjoyment in every possible way their circumstances may require, evince at once the protecting care that has been bestowed upon each living creature, according to its wants, and to the respective sphere in which it was intended to move.

The Mammiferous Quadrupeds therefore, in all their several particulars, form a most interesting branch of Natural History, well deserving of your investigation; and having acquired a knowledge of their structure, habits, and economy, each of which subjects claim your minutest enquiry, and of their general utility, more especially as referable to our own species; you will not fail to be invited to examine the other parts of the Creation; in which you will find the same wisdom and contrivance, and the same providential care, as have been bestowed on the animals, whose history I have now done myself the honour to recommend to your notice.

ON THE WHALE TRIBES.

We come now to a description of animals, to which, from the peculiarity of their internal structure as opposed to their external form and habits, I have deemed it expedient to give a separate consideration. I allude *to the Whale*

Tribes, which Linnæus has placed in his seventh and last order of Mammalia, under the denomination of *Cete*.

These animals are readily to be distinguished from the other divisions of Mammalia, by their living altogether in the ocean; by their external form, which mostly resembles that of common fishes; by their having pectoral fins in the place of legs and feet, by which, aided by a horizontal finny tail, their locomotion is produced; and by their possessing spiculæ, or spout holes on the top of the front of the head, through which they eject with great violence the superfluous water taken in by the mouth, when in the act of swallowing.

In every other particular, they resemble the Mammiferous Quadrupeds; for like them, they have warm, red blood, with a double circulation performed by a heart with two ventricles and two auricles, and by arteries, similar in their construction and action to land animals. They breathe by perfect lungs in the place of gills, which obliges them frequently to rise to the surface of the water for a fresh supply of air. The structure of their brain, of their thoracic and abdominal viscera, and of their bones and muscles, is upon the same principal as in the animals contained in the other orders of mammalia, and like those animals, they produce their young alive, and suckle them. So that it is only in their external form, in their locomotive agents, and in the element in which they live, that a difference may be said to exist.

The animals which belong to this order. are of four kinds: namely, the *Monodon, Narwhal, or Sea Unicorn; the Balœna, or common Whale; the Physeter, Cachalot, or Sperma Ceti Whale;* and *the Dolphin Tribe,* including the common Dolphin, * the Grampus, and the Porpoise. Of these, I propose to confine my history to the three first, as being the most interesting.

The *Monodon, Narwhal,* or, (as it has been familiary termed) the *Sea Unicorn,* is chiefly to be found in unfrozen portions of the Arctic Ocean, where it is occasionally to be seen in herds of great numbers not unfrequently followed by the larger Whales.

This Animal, which from the mouth to the tail, rarely exceeds thirty but is more frequently below twenty feet, in length, is to be distinguished from all the other Genera, by a curious piece of mechanism, consisting of an enormous tooth or tusk) of great solidity and hardness (in a few of

* The Dolphin here alluded to, which is nearly ten feet in length, and is to be met with in the seas of all latitudes, is very different from the *Tropical* fish to which seamen have given that appellation. The latter, Linnæus has denominated *Coryphœna Hippurus.* It is distinguished by the variety and beauty of its colours while near the surface of the water, and when dying; and by the ingenuity it displays in pursuit of the flying Fish, its ordinary food.

the smaller species of two teeth) which resembling a spiral or twisted horn, is attached to the socket of one side of the upper jaw, whence it projects horizontally forward to the extent of nine or ten feet, terminating at its further extremity in a sharp point; thus rendering it one of the most formidable instruments of defence which has been bestowed on the animal Kingdom, being usually destructive to boats of every description with which it may come in contact, and even penetrating deep into the solid timbers of the largest ships.

It is from this projecting tusk (the only tooth given to the animal) that the Narwhal has received the name of the unicorn.

This defensive weapon however does not prevent the enterprizing Greenlander from fearlessly attacking and harpooning the fish for the sake of its flesh, intestines, teeth, and Oil, the latter of which it furnishes in large proportions.—The flesh and intestines, and even the oil, form material parts of the Greenlander's food; but the principal application of the latter, is for domestic purposes, which, in the number of dark days of those latitudes, is an object of the first importance. The tendinous portions of the flesh, are split into small fibres to make thread for their very limited manufactures, and the teeth, which affords very fine Ivory, they barter for other articles, and what they cannot dispose of, they convert into gate posts for their houses. At Rosenberg in Denmark, (as we are informed) there still remains an ancient Throne, composed entirely of the Ivory of the Narwhal teeth, being formerly the seat of state of the Danish Monarchs.

The Narwhal however thus endued with this most formidable instrument of defence, is naturally a timid and inoffensive animal, rarely making use of its physical powers, excepting when closely attacked and wounded; and as it has no teeth but the tusk in the upper jaw, previously described, and as its gullet is extremely contracted, it lives, like the common Whale, upon the sea-blubber, and the smaller fry, peculiar to the seas which this animal frequents.

But the most important of the Whale tribes, are *the Common*, and *the Sperma Ceti Whales*, which not only are of very extraordinary magnitude, but also, furnish in vast proportions, those valuable articles, upon which our arctic commerce so mainly depends.

The Balænæ Mysticetus, or *Common Whale*, (for there are six varieties of the Balænæ genus,) is the largest of all known animals; measuring, in some instances, more than one hundred feet in length, and weighing above a hundred thousand pounds; but those of late years captured, have rarely exceeded two thirds of the above proportions.

It principally inhabits the seas approaching the Poles, but occasionally is to be seen in milder latitudes, and sometimes is even stranded upon the shores of this country.—It is distinguished from all the other tribes, by having no teeth; but as a substitute, the upper jaw is lined with a thick, horny substance, (the whalebone of the shops) the numerous laminœ of which, are so arranged, as to prevent the food, when received into the mouth, from being passed out again; and as the œsophagus, or Gullet, is only a few inches in diameter, the smallest substances, as sea blubber, and other sea insects, or at most very diminutive fish, can only be swallowed; and upon such apparently scanty diet is this immense animal exclusively fed.—And yet, no animal exists, whose blood vessels are so full or so capacious in proportion, as the Common Whale. The aorta, or chief artery, Dr. Paley states, is larger in the bore than the main pipe of the late Waterworks at London Bridge; and the water roaring in its passage through that pipe, is inferior in its impetus and velocity to the blood gushing from the section of a Whale.

Dr. Hunter, upon dissecting one of these animals, ascertained, that the aorta measured a foot in diameter; and he mentions, that through this tube, fifteen gallons of blood were thrown out of the heart at each stroke; which, allowing only twenty pulsations in a minute, would cause eight thousand hogsheads of blood to pass through the heart in twenty-four hours; a circumstance, which admitting its comparative magnitude to other animals, appears still to be almost incredible

Every other part of this Whale is upon the same magnificent scale.—For the heart is so large, as scarcely to be contained in a deep wide tub. The vertebræ, or joints of the back bone, present the diameter of moderately sized barrels. The ribs and jaw bones are often used to form lofty arched gate ways. The tail, (which contrary to the common fish, lies horizontal,) is more than twenty feet broad, and so powerful as to be able to shatter a large canoe to pieces with one single stroke. The cleft of the mouth is from ten to twenty feet in length; while the tongue, is in itself capable of furnishing several hogsheads of blubber; and as the head forms nearly one third of the animal's bulk, and furnishes, in proportion, the largest quantity of oil; this, with the whalebone, supplied (as before stated) from the upper jaw, renders it equally valuable with the still greater bulk of the body, though thickly covered with blubber; a provision of nature apparently for the purpose of preserving the internal viscera from the action of the cooler temperature of the sea, (the Whale having no hair like the land quadruped, or scales like most other fish, as an external covering,) and of giving buoyancy in the water to a body of such immense bulk.

Thus the common Whale, taken in all its parts, from the quantity of Whalebone and Oil which it furnishes, forms in successful voyages, one of the most profitable sources of commerce, which modern times have discovered.

It is worthy of observation, that the two largest animals in existence, the Whale, and the Elephant, should only be formidable, when called upon to defend themselves against their enemies; and that in general, they timidly fly from their pursuers, until urged to resistance by the closeness of the attack.

The *Physeter*, *Cachalot*, or *Sperma Ceti Whale*, though somewhat less than the common Whale, is also of a very large size; and is to be found not only in the North Polar latitudes, but also in the South Seas, and near the coasts of the Brasils and of New South Wales. There are four species, but the *Physeter Macrocephalus* is the most considerable. This animal, contrary to the former, has an extensive range of conical teeth in the lower jaws, which fit into corresponding sockets, in the upper one; containing, as it is supposed by some, small, concealed teeth under the surface. It has also, different from the former, an enormous gullet, by which two circumstances, it is enabled to seize and swallow very large fish; thus bestowing on it, a much more ferocious character than the common Whale. From its head is extracted, that very useful substance, so well known by the name of *Sperma Ceti;* and from its intestines, an inodorous concrete, denominated, *ambergris;* while the fish generally, like the common Whale, furnishes the captors with a vast proportion of oil of a superior quality, which, with the sperma ceti and ambergris, in favourable seasons, most amply rewards the expence and risk incurred in enterprizes of this description.*

Thus the animals contained in the order of Cete, (but more especially the two genera, we have just described,) are rendered doubly interesting; first in a philosophical point of view, by the strong line of distinction which nature has drawn between them and all other fishes; as evinced in the structure and functions of their internal organs, and in the mode by which they produce and give suck to their young, thus approximating them to land Mammiferous animals; while their external conformation, and the element in which they live, would seem to bestow on them the character of fishes. And secondly, in a commercial one, by the application of various parts of their bodies to practical purposes;

* The animals belonging to the first and the last Genus, namely, the Narwhal, and the Dolphin tribes, though furnished with the same oily covering as the others, are too small to be objects of commercial consideration, and therefore are only accidentally destroyed; excepting by the more uncivilized inhabitants of Northerly Countries, by whom they are occasionally used for domestic purposes.

a branch of trade, which, properly directed, rarely fails to advance the country in which it is practised, and to lead to individual wealth and distinction.

FINIS

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