CUVIERIAN CLASSIFICATION

OF

ANIMATED NATURE.

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LADIES AND GENTLEMEN:—Fully recognizing the difficulties that environ the presentation of a scientific subject to an audience composed of professional and non-professional persons, of succeeding in interesting and instructing the latter, and at the same time satisfying the former, is indeed a difficult, if not an impossible task; to secure and maintain the attention of those entirely unfamiliar with the subject, one must generalize to a great extent, and particularly avoid the extended details and the use (to a certain degree) of scientific nomenclature, which would be proper before a body of strictly professional men; influenced by considerations such as these, in directing attention to the subject-matter of the evening, in the brief time allotted, I shall, of necessity, be compelled to treat it in the most general manner, but it is hoped in a sufficiently suggestive and interesting way to awaken a desire on the part of some present to enter upon the study of natural history. If this end should be accomplished, the effort will not have been futile. Man must have his pleasures in this world, and it is far better that those pleasures should lie above rather than below the diaphragm, that they should be of a character to advance and elevate rather than to debase and degrade him. SOCRATES said to his disciples that the most forcible and truthful axiom he had ever met with, was that inscribed upon the temple of Delphus—"Know thyself." What nobler or more interesting study can there be than that of man viewed morally, mentally, and physically? To thoroughly understand man, however, and his place in nature, it is necessary to examine his surroundings of the inorganic and organic world, that we may properly appreciate whence he comes, and whither he goes. Fortunately for us, owing to the efforts of such master-minds as LINNÆUS, CUVIER, OWEN, AGASSIZ and others, the organic world has been classified in such an orderly and methodical manner that its study is far more easy than it was prior to

their time. To CUVIER in particular, the comparative anatomist and the world at large is under lasting obligations, for although in some slight particulars his classification of animated nature has been modified, the accuracy of the plan, as a whole, is made manifest by its universal adoption on the part of naturalists. The knowledge which we possess of the structure and habits of many animals, however, is exceedingly imperfect, and ample opportunities are afforded for those whose tastes lead them in such directions to contribute to the general stock of information, and as an incentive to exertion, it may be stated that new species are being constantly discovered by those who devote themselves to such pursuits. We esteem it a privilege, and eminently improving, to make ourselves familiar with the thoughts of the leading minds of this world, who, like ourselves, are erring and fallible men; but how much more elevating and liberalizing is the study of the works of One who is *infallible*, and manifests boundless wisdom and beneficence in all his works!

Prior to the consideration of the classification of animated nature, it will be advisable to refer briefly to the differences between inorganic and organic matter,—minerals being arranged under the head of the inorganic, vegetables and animals under the organic. In the inorganic there are no organs for the performance of specific functions, and no such thing as birth, life, or death; in the organic, on the other hand, all of these prevail, and organized bodies being derived from similar ones, the necessity for parents seems to be invariably manifest; and the axiom of HARVEY, "*omne vivum ex ovo*," from a seed or egg every living thing arises, appears to prevail throughout. The theory of *spontaneous generation*, which supposes that living objects may arise by the conjunction of the elements of decaying animal or vegetable matter, has been subjected of late to the most rigid examination, and apparently becomes more and more improbable the closer it is investigated.

In form, size, chemical composition, preservation, and duration, the contrast is most striking between the inorganic and organic. Inorganic matters are aeriform, liquid, or solid, and are prone to assume the crystalline form, and the smallest particle of chalk is the same in structure and composition as the largest chalk cliffs on the sea-coast. These may exist apparently unchanged for ages. Organic bodies, on the contrary, consist of an assemblage of organs, each body has a definite form and size peculiar to its species, by which it is distinguished from all others, and the evidence of incessant change in them is readily observable. Inorganic bodies, by chemical analysis, may be resolved into about sixty-five simple substances or elements, that is to say, which have hitherto resisted decomposition on the part of the chemist. These elements unite in certain definite proportions to form the compound inorganic substances which surround us on all sides. Of these sixty-five simple elements, only about seventeen enter into the composition of organic bodies, vegetable or animal.

The preservation of the individual makes it necessary that organized bodies should be supplied with food. This the plant obtains by absorbing to itself inorganic matters, such as carbonic acid, water, ammonia, and the earthy salts, from the surrounding atmosphere and soil, and animals feeding upon vegetables and upon each other secure materials sufficient to supply the waste which is constantly going on in their organisms. It is not only necessary to attend to the preservation of the individual, but the perpetuity of the species is equally important, and this is secured by the union of the sexes. The duration of the individual is limited; in other words, it has a definite period of existence, divisible into ages, at the termination of which death invariably ensues, and the material which entered into the composition of the vegetable or animal is returned to the earth and atmosphere, from which it was originally obtained, to be again resolved into the simple elements. Even during life, however, this constant interchange between the inorganic and organic is taking place; in every act of respiration, oxygen is obtained from the atmosphere in inspiration, and carbonic acid gas given off to it in expiration; the food that is taken into the body, vegetable or animal, is only so much matter which was originally obtained from the inorganic world, and after subserving the purposes of the economy, is again returned to the source whence it came in the different excretions of the body. Constant change is thus taking place, not only in the organic, but also in the inorganic world, the former absorbing materials from the latter at one time, to be replaced at another. The elements which enter into the composition of our body indeed are only borrowed from the earth and surrounding atmosphere, and united together by the operation of the natural forces, and then, after a brief period, this relation is dissolved, and the constituent elements separate, to again enter into new combinations. This constant absorption from and return of materials to the earth and atmosphere by organized beings keeps up the continuous stream of life, and renders the source inexhaustible. The Rev. Mr. Malthus, an eminent mathematician, demonstrated years ago, by a most minute and accurate calculation, that if there was not constant death as well as birth, organic beings, increasing under such circumstances, in a geometrical ratio—and as the means of existence cannot be made to increase in the same ratio—a condition of affairs eventually would be reached when there would be neither food nor space on the globe sufficient to accommodate the necessities of vegetables and animals. The constant interchange between the organic and inorganic, in the dying out of the old, not only affords place for the new, but also gives to the face of nature the freshness and vitality which are so pleasing to our senses and so invigorating to our physical and mental powers. The fossil remains in the geological strata indicate most conclusively that ages upon ages long before the world was habited by man, or was a fit place of habitation for him, death prevailed among vegetables and animals. In this record, the

grave-yard of past ages, is exhibited in chronological order one of the most beautiful evidences of the harmony of nature's laws, and the wonderful system and wisdom of God: first creating the lower forms of organic life, and then in different geological ages, through successive stages of advancement, one class of animals after another appearing, until eventually the world is prepared for the maintenance of man. Thus, in the PRIMARY or PALÆOZOIC AGE, FISHES were the masters of creation; in the SECONDARY AGE air-breathing animals first appeared, the REPTILES predominating over other animals; in the TERTIARY AGE, terrestrial MAMMALS of great size present themselves; while it is not until the MODERN AGE that the reign of MAN begins. In the TESTIMONY OF THE ROCKS, by HUGH MILLER, and in the RELIGION OF GEOLOGY, by the REV. DR. EDWARD HITCHCOCK, President of Amherst College, are embodied conclusive arguments in substantiation of the statements relative to fossil remains. The facts presented indicate most clearly that the matter which entered into the composition of animals and vegetables in the earliest period of the world is still in existence; and that we are formed of materials as old as the creation, which have served the purposes of beings anterior to and during our own time, as we, in turn, by constant disintegration of our tissues, yield up the matter of which we are composed, to furnish material for new existences. What we call death or destruction is not therefore *annihilation*, but change, for there is no such thing as the annihilation of matter or of force; either may disappear from our view, but they are not destroyed, they are only changed in form, and will reappear in some other shape. In illustration of this, BRYANT, America's great poet of nature, has forcibly said:

> "Go forth, under the open sky, and list
> To nature's teachings, while from all around
> Earth and her waters, and the depths of air,
> Comes a still voice. Yet a few days, and thee
> The all-beholding sun shall see no more
> In all his course; nor yet in the cold ground,
> Where thy pale form was laid, with many tears,
> Nor in the embrace of ocean, shall exist
> Thy image. Earth, that nourished thee, shall claim
> Thy growth, to be resolved to earth again,
> And, lost each human trace, surrendering up
> Thine individual being, shalt thou go
> To mix forever with the elements,
> To be a brother to the insensible rock
> And to the sluggish clod which the rude swain
> Turns with his share, and treads upon. The oak
> Shall send his roots abroad, and pierce thy mould."

To some persons, the idea that the materials that enter into the composition of their bodies is to be thus used may carry with it rather unpleasant associations. To a sentient being, however, who, in his day and

generation does everything in his power to ameliorate the sufferings, contribute to the happiness, and elevate the condition of his fellow-man; who recognizes that, while made in the *spiritual* image of God, he has a *material* body like that of other animals, which is but a dwelling-place for the spirit during a brief period, and when the tenement becomes unfit for it as a place of habitation, returns to the source whence it came, there is something delightful in the consciousness that even the materials which form part of his organism are not to be wasted, but, on the contrary, will be employed for some useful purpose, perchance to become part and parcel of a noble oak, that shall please the eye, and shelter from the storm or the heat of the sun a fellow-being; or enter into the composition of a beautiful flower, whose fragrance shall impart to the surrounding air an aroma grateful and exhilarating to all.

Having directed attention in a general way to the characteristic differences between inorganic and organic matter, the dependence of the latter on the former, and the constant interchange which takes place between them, the way is opened to more properly appreciate the classification of animated nature.

In every department of science, classification has two prominent purposes to subserve: first, to organize the knowledge which has been gained through the exertions of innumerable investigators by having it arranged in a methodical manner so as to render its acquisition, retention, and use most easy and successful; second, that it may be employed to facilitate identification, or the recognition of the resemblances or differences existing between facts or objects embraced in the line of study, and in that way enable observers who are familiar with the great principles underlying science and their special applications to confirm or disprove mooted points, or by the discovery of new objects or new principles to add to the general stock of knowledge. The importance and advantage of a regular and systematic arrangement of science are never more apparent than when men of fair perceptions, respectable abilities, and liberal attainments, but who lack the essential quality of an orderly arrangement of the knowledge they have acquired, attempt to present their views either as speakers or writers; for in place of offering them in a clear, connected, and comprehensive manner that would secure attention and benefit listeners or readers, they are presented in such a disjointed and incoherent way that the usefulness and efficiency of their efforts are greatly impaired. Were it not that in all ages the master-spirits of science, those broad, generalizing, and philosophical minds, who, in addition to patient, laborious investigation on their own part, taking advantage of the recorded facts of reliable observers, have always endeavored to discover the great cardinal principles upon which science rests, and by demonstrating the existence of certain fixed laws have in this way simplified its study by arranging a number of apparently isolated facts or objects in well-defined groups, it would be im-

possible at the present day for any mind, however vast the power or remarkable the memory, to grasp, retain, or successfully manage such heterogeneous masses of material as would exist without classification. As SIR JOHN HERSCHEL has said, "Science is the knowledge of many, orderly and methodically arranged and digested, so as to become attainable by one." To no department does this apply with more force than to Natural History, and from the time of its founder, ARISTOTLE, naturalists, by a careful study of the resemblances and differences presented by animals, have endeavored to arrange them into well-defined groups, bringing together those which have certain marked resemblances, and separating these from others that are dissimilar to them.

In many respects, the observations and suggestions of the Greek philosopher in relation to animated nature have not been improved upon during two thousand years, but in one most important particular he made a very great mistake. Supposing that a differential characteristic existed in the presence or absence of blood, and regarding as such only that fluid which has a red color, in his first division of animals, ARISTOTLE classified them in two primary groups, as ENAIMA, sanguineous, or possessing blood, and ANAIMA, exsanguineous, or without blood. This arrangement prevailed for a long time, but eventually, when it was found that many of the latter group possessed blood, although of a different color, his divisions were still retained, but spoken of as those with "red blood" and those with "white blood." In the minute and careful dissections of the lower animals by CUVIER, he discovered red blood in some of the worms which had heretofore been regarded as only possessing white blood; this demonstrated the utter fallacy of the distinction just referred to. LAMARCK then observing that certain animals possessed a vertebral column (the backbone of common parlance), which is entirely absent in a far greater number, proposed to classify them as the VERTEBRATA and INVERTEBRATA. This classification is still employed by naturalists as a matter of convenience, but the recognition of the fact that while the first group is based upon the possession of a positive characteristic, the other is due to a negation, lessened its value, and particularly after the important discovery that the vertebral column is subordinate to a higher office than merely serving as a central axis to the skeleton, viz.: affording lodgment and protection to that important and delicate nervous mass, the spinal cord, while its expanded portion, the brain, is safely lodged in the skull. This led CUVIER to investigate the nervous system of the invertebrata, and discovering, as the result of elaborate dissections, important modifications of that system in them, he established the four "GREAT DIVISIONS" or "SUB-KINGDOMS" of the ANIMAL KINGDOM, which are so well known, have contributed so much to facilitate the study of Natural History, and immortalize his name. His "GREAT DIVISIONS" are divisible into "CLASSES," these again into smaller groups named "ORDERS," ORDERS into "FAMILIES," FAMILIES into "GENERA," and the latter into "SPECIES."

ARISTOTLE had used GENERA and SPECIES to distinguish between larger and smaller groups; and LINNÆUS, who did much to systemize the study of animals, added to these CLASSES and ORDERS; but all these terms were employed by him in a manner that frequently induced great confusion, and it was not until the promulgation of CUVIER'S plan that the classification of animated nature could be said to have a firm and reliable basis. A general idea of his system may be gained by reference to the diagram on the blackboard, which I have arranged so as to offer in a tabular or skeleton form his plan, with the modifications that appear to me to adapt it—at least to a certain degree—to the present condition of Zoology; it presents in particular that portion of the Animal Kingdom, the vertebrata, with which you are most familiar.

KINGDOMS.

MINERAL. VEGETABLE. ANIMAL.

ARCHETYPES.

VERTEBRATA. ARTICULATA. MOLLUSCA. RADIATA.

CLASSES.

PISCES. REPTILIA. AMPHIBIA. AVES. MAMMALIA.

SUB-CLASSES.

1. VIVIPARA, OR PLACENTALIA.
   - UNGUICULATA. — ORDERS. BIMANA. QUADRUMANA. CHEIROPTERA. INSECTIVORA. CARNIVORA. CETACEA. RODENTIA. EDENTATA.
   - UNGULATA. — PACHYDERMATA. RUMINANTIA.

2. OVOVIVIPARA. OR IMPLACENTALIA. — MARSUPIATA. MONOTREMATA.

FAMILIES.

GENERA.

SPECIES.

In the construction of his classification, CUVIER was largely indebted to the labors of naturalists who had preceded or were contemporary with him,* and it has undergone and must continue to undergo modifications

* In the preface to the first edition of CUVIER'S great work, THE ANIMAL KINGDOM, he says: "Had I been constrained to depend upon myself alone, I should not have been able to prepare even the simple sketch I now give; but the resources of my position seemed to me to supply what I wanted both of time and talent. Living in the midst of so many able naturalists, drawing from their works as fast as they appeared, enjoying the use of their collections as freely as themselves, and having formed a very considerable one myself, especially appropriated to my object, a great portion of my labor consisted merely in the employment of so many rich materials."

and improvements on the part of subsequent observers. It is based upon the recognition of a unity of plan or conformation of structure among beings apparently dissimilar to each other. In the arrangement of the different groups advantage is taken of certain general plans of organization observable in animals; the adaptation of their bodies for swimming in the water, creeping or walking on the land, or flying in the air; the structure and peculiarities of their limbs; the form and structure of their teeth, or the absence of the latter, etc. To properly understand the classification it is necessary to take up the different groups in regular order. In describing them, a number of technical terms of necessity will have to be employed. These, however, will be carefully defined, so that persons least familiar with them may understand their meaning; in this connection it may not be amiss to state that the objections urged against the use of Greek and Latin terms in scientific nomenclature are not well founded. The aim is not to mystify, but rather to simplify science by their use; for in the employment of universal languages such as Greek and Latin, a single name applied to a given object will answer better the purpose, and be far more easy of remembrance, than to be compelled to memorize half a dozen names in as many different languages. That which the masters of science have seen fit to use, you may rest assured is right. Commencing with

KINGDOMS.

MINERALS, VEGETABLES, and ANIMALS are arranged under this head. Having already stated that these are divisible into the inorganic and organic, it is only necessary to consider the characteristic resemblances and differences between animals and vegetables. They agree in originating from parents in an *egg* or *seed*, and in the fact that the various structures which enter into their composition commence in a *cell*, and in the integrity of the organism during life, vegetable or animal, being maintained through the continuous operation of millions of these cells. In these is found that *unity of organization* which naturalists had been dreaming of and philosophizing about for ages, but which was left for SCHLEIDEN, SCHWANN, and VON BAER to discover and demonstrate in our own day.

They also resemble each other in the possession on the part of each of the organic or nutritive and the reproductive functions, viz.: Digestion, Absorption, Respiration, Circulation, Nutrition, Secretion, Calorification, and Generation. In addition to these, animals possess *Sensation* and *Voluntary Motion*, functions which are not enjoyed by the Vegetable. The latter, fixed to the soil, is enabled to derive from it and the surrounding atmosphere materials inservient to its nutrition; and although some of the lower forms of animals are fixed to one spot during their entire life, and give little evidence of the possession of sensation or voluntary

motion, and lead an almost vegetative existence, the vast majority possessing the means of locomotion, and a central organ or stomach for the reception and digestion of food, are compelled to pass from one place to another in search of it. The well-defined differences, readily recognizable by the most ordinary observer in the higher forms of vegetables or animals, renders it very easy to distinguish one from the other, but the lowest types of each require the exercise of great care on the part of naturalists to decide which they belong to. As an illustration of this, the sponge at one time was regarded as a vegetable, while it is now fully recognized as belonging to the Animal Kingdom. The simplest means of demonstrating whether a certain structure has a vegetable or animal origin is to burn it; under such circumstances, the latter invariably gives off a peculiar and unmistakable odor sufficient to decide the point beyond a question of doubt.

ARCHETYPES.

The primary divisions of the ANIMAL KINGDOM have been denominated SUB-KINGDOMS, DEPARTMENTS, etc.; but I prefer to employ, in place of any of these, ARCHETYPES, on account of the fact that the hundreds of thousands of species have been arranged, as the VERTEBRATA, ARTICULATA, MOLLUSCA, or RADIATA, according to *four general plans of construction* observable in them. The last-named, however, is regarded by many naturalists as being defective, and another sub-kingdom, the PROTOZOA, is now generally agreed upon, and the propriety of recognizing two or more in addition to this is strongly urged by eminent observers.

The VERTEBRATA (Lat. *vertere*, to turn) are so named on account of the presence of the vertebral column, which at its upper extremity is expanded into the skull, and terminating in animals in a tail, consists of a series of bones, so arranged as to give flexibility of motion, serve as a central axis for the rest of the skeleton (which is internal), and afford, as already stated, lodgment and protection for the spinal cord, while the brain is safely lodged in the skull. Connected with the sides of the vertebræ are a series of ribs, which are generally united in front with the *sternum*, or breast-bone, thus forming a cavity which affords protection to the organs of respiration and circulation; in addition to the ribs, two or four extremities are usually appended for purposes of locomotion. The bones are united by ligaments, and moved by muscles, which pass from one bone to another. All of these animals have red blood, with a muscular heart to propel it; some of them, however, are *warm blooded*, while others are *cold blooded*, in other words, the first maintain a uniform temperature, 98° F., while the other rises and falls with that of the surrounding medium. They are also endowed with the five special senses, smell, sight, hearing, taste, and touch, and furnished with two jaws, one above or in front of the other, which are frequently supplied with

teeth for the purpose of masticating the food, or to be used as organs of offense or defense. In many the teeth are entirely absent, as in birds, etc.

The ARTICULATA (Lat. *articulus*, a joint) are formed of a number of pieces or segments united or articulated together. The skeleton, when present, is invariably external, and incloses not only the nervous system but the muscles which move the body. The various portions are articulated together so as to admit of great freedom of motion to the body and extremities, the latter of which, when present, are quite numerous, never being less than six, and sometimes reaching one hundred in number, as in the centipede. In the worms and leeches, the body is merely surrounded by a soft envelope, in which the segments cannot always be readily observed. The blood, which is white, circulates, except in the higher forms, without a central organ or heart. The organs of vision, taste, hearing, and touch have been observed in them. The jaws, usually more than two in number, open laterally.

The MOLLUSCA (Lat. *mollis*, soft) are distinguished by negative rather than positive characters; they have neither an articulated skeleton nor vertebral column, and the organs of motion and sensation are of a low order, and some of them are fixed to one spot, except during the earliest periods of existence. The body is enveloped in a loose mantle, which in some is capable of secreting one or two shells, which afford protection, and serve the purpose of an external skeleton. The blood is white or bluish white, and propelled by a heart of simple structure.

The RADIATA (Lat. *radius*, a ray) unquestionably hold the lowest rank of the four definite types of structure under which all the higher forms of animal organization may be classified. The predominance of the vegetative or nutritive apparatus over those of animal life is quite conspicuous. The radial symmetry which it presents makes it approximate in general resemblance to plants, and on account of this some of them have been denominated ZOOPHYTES (Gr. *zoon*, animal, *phyton*, plant); these are fixed to the ground and have the form of plants. In some of the Radiata, as in the sea-urchin and star-fish, the skeleton is external, while in the polypi it is sometimes internal. Most of them have a mouth and stomach for the reception of food, while others absorb it through their exterior, like plants; the radiated character, while readily observable in some, is absent in others, and it is this which has given so much dissatisfaction and has induced the establishment and recognition of a fifth Sub-Kingdom.

The PROTOZOA (Gr. *protos*, first, *zoon*, animal) are in general exceedingly minute microscopical objects found specially abundant in water; a large proportion of them consist of single cells or aggregation of cells, but their animal character is made manifest by their movements and mode of nutrition. PROF. AGASSIZ contends that these minute beings do not constitute a natural group; and he believes that they are only imperfectly

understood, and that eventually many of them will be distributed among vegetables, and others to one of the four primary divisions of animals.

CLASSES.

The ARCHETYPE VERTEBRATA are divisible into four CLASSES, based upon the *performance of some special action or function peculiar to each class.* All of these agree in possessing a vertebral column, but differ in other peculiarities of structure, as follows:

The PISCES (Fishes), the lowest class of the Vertebrata, are only formed to live in water; they are OVIPAROUS (Lat. *ovum*, an egg, *pario*, I bring forth); in other words, all but a few species lay eggs. The vertebræ generally present a concave surface to each other, and the space thus formed is occupied by a sac of fluid, that gives very great latitude of motion to the spine, which is sometimes cartilaginous. The tail is generally expanded into a broad fin, and is the principal instrument of progression. In addition to this, there are two pectoral and two ventral fins, which aid in locomotion. Being strictly aquatic in their habits, they respire through the medium of the element in which they live by means of gills. They are cold blooded, and the heart is composed of two cavities, an auricle and a ventricle, which receive the venous blood from the system, and propel it over the respiratory surface whence it is collected into an arterial trunk, the aorta, by which it is distributed over the body, without the intervention of a systemic heart. The body is usually covered with scales.

The REPTILIA (Lat. *repto*, I creep) include a large class of animals, many of which differ so much in form that those who are unacquainted with the subject would hardly suppose that serpents, lizards, and tortoises are all arranged under the same head. The vertebræ of the serpents articulate like a ball-and-socket joint, by which these animals are enabled to coil themselves up in the form of a ring. This class is for the most part adapted to the surface of the earth, and those which live in the water are obliged, with few exceptions, to come to the surface to breathe, as they are provided with lungs in place of gills. The general habits of all of them are lazy, and in cold and temperate climates they pass almost the entire winter in a state of lethargy. With the exception of a few species which bring forth their young alive, they are all oviparous and cold blooded. The heart usually consists of three cavities: one, the systemic auricle, receiving the blood from the body, and another, the pulmonic auricle, from the lungs; both of these cavities communicate with a ventricle, whence the blood is propelled through the body as well as to the lungs. Certain animals, which were formerly arranged in this division have been placed in a separate class; they are

The AMPHIBIA (Gr. *amphi*, both, *bios*, life), so named on account of the faculty which these animals possess of living in the water or on the land; it includes the frogs, toads, salamanders, etc. During their earlier and

immature existence, as tadpoles, they partake of the character of fishes, but eventually undergo a peculiar metamorphosis, during which the extremities are developed, and they then approximate to Reptiles in their general structure and mode of respiration, and, like them, are oviparous, cold blooded, and merely covered with a thin skin.

The AVES (birds) are formed for rapid motion in the air, and the bones of the skeleton are quite light and hollow, which greatly lessen the specific gravity of the body. The anterior extremities are invariably constructed so as to aid in flight, while the actions of standing, walking, scratching, and swimming demand different modifications of the posterior extremities. Their jaws are furnished with a horny bill, varying in form according to the nature of the food. The divisions of this class have been chiefly founded by ornothologists on modifications of the bill and feet. They are oviparous, and the ovum, inclosed in a calcareous shell, is perfected by incubation after extrusion from the body. Possessing a double circulation, systemic and pulmonic, with a heart having two auricles and two ventricles, along with the most perfect respiratory apparatus; circulation and respiration are rapid, and they are consequently warm blooded, their temperature frequently rising as high as 107° F. The feathers which cover them, acting as a non-conducting medium, serve to retain their heat.

The MAMMALIA (Lat. *mamma*, a breast), so named from possessing mammary glands to suckle their young, are the most highly organized class of animals. Taken as a whole, they are not characterized so much by the possession of any particular faculty as by the perfect combination of the different powers, which render the animals belonging to it capable of a much greater variety of actions than any others can perform. They are distinguished in particular by the high evolution of that portion of the brain named the cerebrum, which is regarded as the seat of intelligence and the reasoning faculties, whereby means are adapted to ends for the purposes of the individual. These attributes reach their highest development in man. It is the recognition of these facts which has induced the naturalist to place this class at the head of the Animal Kingdom. Like Birds, they have warm blood, a heart, with four cavities, two auricles, and two ventricles, and a perfect pulmonic and systemic circulation. Provision is made for the regular renewal of the air in the lungs, not only by the movements of the ribs but by the action of the diaphragm. The temperature of this class is about 98°. To confine the heat and prevent its rapid absorption by the surrounding atmosphere in cold climates, many of these animals are liberally supplied with hair or fur. The immense quantities of blubber or fat under the thick skin of the whales serve the same purpose.

Sub-Classes.

The Class Mammalia are divisible into two sub-classes; the first of which, the vivipara (Lat. *vivus*, alive, *pario*, I bring forth), embracing ten orders, bring forth their young alive; the second, the ovovivipara (Lat. *ovum*, egg, *vivus*, alive, *pario*, I bring forth), produce living young in a more immature state than the former, the egg being developed within the body of the parent, without any connection with the womb, by means of a placenta; of these there are only two orders.*

Orders.

The Mammalia are thus divisible into twelve orders, *founded upon certain well-marked peculiarities of structure*, and in arranging them advantage is taken of external and easily recognized differences: the variations of structure in the extremities, and the arrangement, form, and structure of the *teeth in particular*, serving as valuable guides or aids in this respect. It would be interesting and profitable to dwell at length on these points and their characteristic manifestations, while reviewing the different orders, but this would consume too much time now, and not be in accordance with the plan of the lecture. It will suffice to say, in general terms, that the sub-class placentalia includes animals whose extremities present two specific points of difference, and it is therefore divided into, first, the unguiculata (Lat. *unguis*, the nail or claw), including eight orders which have their extremities armed with nails or claws, but free for the exercise of touch upon their under surface. Six of these orders are Carnivorous, while two of them are Herbivorous. 2d. The Ungulata (Lat. *ungula*, a hoof) embrace two orders, having hoofed extremities and feeding upon vegetables. The two orders of the Implacentalia have extremities which entitle them to be classed with the Unguiculata; they vary, so far as their food is concerned, a few being Carnivorous, the majority Herbivorous. The teeth of these different orders generally correspond with the extremities and with the character of the food, being sharp and pointed in those possessing claws and feeding on flesh, while they present broad grinding surfaces in the animals having hoofed extremities and feeding on vegetables. The Unguiculata are:

The Bimana (Lat. *bis*, twice, *manus*, hand), including the single Genus, homo, or man, present as physical characteristic in contradistinction to other animals, the maintenance of the erect position; and the possession of two hands with an *opposable thumb*, that enables man to accomplish

* Prof. Owen arranges the above sub-classes as follows: the first as the Placentalia (Lat. *placenta*, a cake), in which a soft vascular body is found adherent to the uterus and connected with the fœtus by the umbilical cord; the second as the Implacentalia, or those without a placenta. The distinction thus established is much more satisfactory than the first, from the fact that the young of each sub-class are brought forth alive.

a variety of things by its aid which no other creature can effect. He is furthermore distinguished for the possession of articulate language or speech, and the power of not only communicating his thoughts to his fellow-man in his own day and generation, but with the aid of the hand in writing, to transmit them to posterity. Not only the character of his teeth, but other circumstances prove that he is *Omnivorous* (Lat. *omnis*, all, *voro*, I devour), or in other words, he is intended to live on a mixed diet, vegetable and animal.

The QUADRUMANA (Lat. *quatuor*, four, *manus*, hand) embrace monkeys, apes, etc., all of which possess four hands, somewhat, but not exactly, analogous to the hand of man; they might be compared indeed with as much propriety to his foot as to his hand, as they are all used for locomotion. Although able to stand nearly erect, their natural position when moving about is mainly on all-fours.

The CHEIROPTERA (Gr. *cheir*, hand, *pteron*, wing) are animals having the anterior extremities, and especially the hands, so modified as to serve the office of wings. This ORDER includes the bats, which were formerly regarded by naturalists as birds, but the possession of teeth, and suckling their young like other Mammalia, clearly demonstrate the CLASS to which they belong.

The INSECTIVORA (Lat. *insectus*, an insect, *voro*, I devour), such animals as the hedge-hog, mole, and shrew, feed exclusively upon insects.

The CARNIVORA (Lat. *carnis*, flesh, *voro*, I devour) have teeth which are peculiarly adapted for seizing upon and destroying living prey and tearing their flesh. The lion, tiger, bear, dog, seal, etc. all belong to this order.

The CETACEA (Lat. *cetus*, a whale) were formerly regarded as fishes, but the possession of warm blood, bringing forth their young alive, and suckling them, prove that they belong to the Mammalia. Those which are provided with teeth seize upon large marine animals, while others that have none, derive their support from the smaller kinds by engulfing them with a large quantity of water in their capacious mouths. There are others again that are strictly Herbivorous, which some naturalists arrange as a distinct ORDER, the SIRENIA.

The RODENTIA (Lat. *rodo*, I gnaw), comprising rats, mice, beavers, squirrels, rabbits, guinea-pigs, etc., are characterized by having two large incisors in each jaw separated from the molars by a wide space; these teeth have enamel on their front surfaces only, so that their posterior border being worn away more than their anterior, they are always kept set like a chisel.

The EDENTATA (Lat. *e*, privative or deprived of, *dens*, a tooth), including the sloth, armadillo, ant-eater, etc., have no incisors or front teeth.

The two ORDERS arranged as UNGULATA are,

The PACHYDERMATA (Gr. *pachus*, thick, *derma*, skin), distinguished for

the thickness of their skin, and include the horse, hog, tapir, rhinoceros, and elephant, the last of which, from the fact of possessing claws, is an unguiculated animal.

The RUMINANTIA (Lat. *rumino*, to chew the cud) comprise those animals which possess a compound stomach, and who, after their food has been taken into the mouth and swallowed, regurgitate it by the stomach throwing it back into the mouth to be rechewed as a *cud*, when it is again swallowed, and, by a peculiar elongation of the œsophagus, the bolus, in place of entering the first cavity as it did in the previous instance, passes on to the third. The ox, sheep, deer, etc. are contained in this ORDER. The first two of these are named *hollow horned*, on account of their having hollow horns projecting in front of the skull that are never shed. The deer, on the contrary, are called *solid horned*, from the fact that the antlers are solid like bone. These are cast or shed and renewed each year. All of these animals, with the exception of the camel, have no front teeth in the upper jaw. The camel is also unguiculated.

The SUB-CLASS IMPLACENTALIA embrace the last two ORDERS of the MAMMALIA, as follows:

The MARSUPIATA (Lat. *marsupium*, a pouch) are so named on account of the presence of a pouch in the front and lower part of the abdomen of the females, which serves as a temporary abode for the young after birth. The kangaroo and opossum belong to this ORDER.

The MONOTREMATA (Gr. *monos*, one, and *trema*, perforation) have a common outlet for the generative and excremental products, and in this respect they resemble birds.

The different ORDERS thus briefly referred to are each divisible into

FAMILIES.

Much confusion is induced by the careless manner in which many naturalists employ the term FAMILY, frequently using it as synonymous with ORDER. Such, however, is not the case; for each FAMILY is made up of GENERA that resemble each other in certain particulars, and are separated from other GENERA which belong to the same ORDER, *on account of some modification of form or structure*. Thus the dog, which belongs to the FAMILY CANIDÆ (Lat. *canis*, a dog), is distinguished from the bear, belonging to the FAMILY URSIDÆ, not only by the *form of the body*, but also by walking upon the *ends of the toes* in place of the *sole of the foot;* this being due to a *structural difference* in the shape and articulation of the bones in the lower part of the limbs. Both of these FAMILIES belong to the ORDER CARNIVORA.

GENERA.

As already stated, the ORDER BIMANA includes only a single GENUS, HOMO, or man. Divisible, however, as most ORDERS are into Families

embracing several GENERA, *minor details of structure* frequently serve as generic characteristics; thus, *advantage is sometimes taken of such slight anatomical peculiarities as "the number, disposition, or proportions of the teeth, claws, etc."* in the carnivora, to distinguish one *genus* from another.

SPECIES.

As the anatomical differences which separate GENERA of the same FAMILY are so slight, it would be reasonable to infer that the division of a GENUS in SPECIES must be based upon peculiarities still less marked, and such is the case. Thus, *"color, size, proportion*, etc." serve as means for the recognition of different SPECIES of the same GENUS. "The principal characteristic of species is the power of producing beings like themselves who are also productive. A species may be modified by external influences, and thus give rise to races or varieties, but it never abandons its own proper character to assume another."

To recapitulate briefly: the ANIMAL KINGDOM, embracing all animals, recent or extinct, is divisible into ARCHETYPES, *according to four general plans of construction observable in them;* these again into CLASSES, *based upon the performance of some special action or function peculiar to each class;* these into ORDERS, *founded upon certain well-marked peculiarities of structure;* these into FAMILIES, *on account of some modification of form or structure;* these into GENERA, to distinguish which, advantage is sometimes taken of such *slight anatomical peculiarities as the number, disposition, or proportion of the teeth, claws, etc.;* and lastly, the latter into SPECIES, in which *color, proportion, and size* serve as characteristic differences. This is the key to the CUVIERIAN CLASSIFICATION OF ANIMATED NATURE, and which unfortunately many persons who have devoted years to the study of natural history apparently have the most confused and erroneous ideas in relation to. *Comparison* throughout is the basis upon which the entire system rests, and it has its foundation in *nature* rather than art.

In conclusion, like a traveler who, on the top of a mountain, taking in an extended view of a new and beautiful landscape beneath, observes here and there prominent objects of interest, on descending to the plain finds an immense number of minor objects claiming his attention, is better prepared to understand the exact relation one part bears to another, so it is trusted that this address may answer a similar purpose to some of you in the study of Natural History. In the facts that have been thus imperfectly presented, my aim has been to give them in a plain, simple, and comprehensive manner; but embracing, as the remarks have, only a general and hasty survey of leading points, they should be regarded by those who may desire to become better acquainted with the subject-matter as merely introductory to a regular course of study in this direction.