RHIND'S ZOOLOGY

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ELEMENTS

OF

ZOOLOGY.

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ZOOLOGY;

EMBRACING

A VIEW OF LIFE AS MANIFESTED IN THE VARIOUS
GRADATIONS OF ORGANIZED BEINGS.

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PREFACE.

The object of this little work is to afford to students a concise but connected and systematic view of the vital functions, and the varieties of animal structure as exemplified in the graduated scale of existence.

As it is intended to serve as a text-book for more extended lectures, a general view of the classification of the animal kingdom is also given. In this synopsis, the arrangement of Cuvier is taken as the basis, with a few exceptions, which are pointed out in the table at the end.

The illustrative woodcuts are confined chiefly to the elucidation of organic structure; an engraved atlas of the leading orders and genera of animals is proposed to be afterwards published as a suitable accompaniment.

In using this work as a class book for junior pupils, certain portions may be at first selected; as the sections on the senses and instinct, or a class of animals, as the mammalia — birds — insects; while, to the advanced student, a course of more extended reading, as pointed out in the authors subjoined, may be followed, along with the perusal of the entire treatise.

The utility of early training, in the various departments of natural science, is daily becoming more obvious to the public generally; and there is no doubt but that a period will soon arrive when such studies will be recognized as regular branches of education in our schools and academies in this country, as they have long been with the greatest success in similar establishments on the Continent.

EDINBURGH, 21, FORTH STREET,
April, 1839.

CONTENTS.

ZOOLOGY.

SECTION I.

FORM AND COMPOSITION OF ORGANIZED BODIES.

1. ZOOLOGY embraces the history of animated beings, or all those organized bodies which exhibit the phenomena of sensitive life.

It includes an account of the structure and uses of the various parts of the animal machine, points out the difference of this structure in different tribes, and thus affords the means for classifying and arranging the numerous gradations which are found in the vast chain of animal existence.

Zoology also treats of the habits, dispositions, and instincts of animals, their dispersion over the globe, and the effects which climate, domestication, and other causes, produce on them.

2. Although plants are also organized bodies, exhibiting life in a certain degree, and possessing a property, called *irritability*, of being affected by external stimuli, yet they have no real sensation, and thus differ from animated beings.

3. Organized bodies differ from inorganic or mineral substances, in having a structure, more or less complicated, made up of cells, tubes, and membranes, intimately connected together, yet performing separate functions or offices, and obeying different laws from those which prevail in the inorganic kingdom.

If you take a mineral substance, and break it into minute parts, every part is complete in itself, and is identical, in every respect but size, with the body from which it was broken; but if you divide an animal thus, every part differs from the other, and it is only by the junction and combination of numerous parts and structures that you have a perfect whole. Mineral bodies are subject to mechanical and chemical laws; but, in addition to those, organized bodies are under the control of vital laws, which enable them to resist the ordinary effects of chemical and mechanical actions. It is only when vital actions cease that organized bodies become subject to chemical decomposition, and are again resolved into the elements out of which they were formed.

4. An animal body is said to be possessed of *organs*, or to have an organism. These organs perform certain *functions*, which are necessary for the growth and support of the individual—for its locomotion, and for the performance of instinctive and rational acts.

The performance of these functions constitutes life,—a term which comprehends the whole manifestations of an animated being.

For the manifestations of life, then, there is first necessary an organized body susceptible of vital action, and certain stimuli to act upon this body, and set it into motion and activity.

In this view of the subject, organism is made to precede life.

Another theory supposes a "vital principle," an actual though incomprehensible agent, which is the cause of organization, and all the functions, both vital and sensitive, of the animal machine.

We are told, that in the beginning the Creator first formed the organized structure, and then "breathed into it the breath of life;" and ever since the perpetuation of every individual species continues to be accomplished by the transmission of a portion of this organized matter from parent to offspring.

There can be no doubt, from all experience, but that an organized structure precedes, or is co-existent with, the manifestations of life; and yet we are by no means assured that life is the consequence simply of organization; that is, that matter, under certain laws called vital, and acted on by certain material stimuli, produces all the manifestations of life. We know not whether sensation, or even irritability, be a property of matter simply as matter, or whether both may not be due to the presence of another principle, the nature of which is to us incomprehensible.

At the same time, those who assume the agency of a vital principle, do so on theoretical grounds alone. It is an hypothesis, in its general acceptation, inconsistent with the fact already noticed, that all experience shews organized matter as essential to the manifestation of life.

Nothing can be more illogical, however, than the reasonings of the materialists, that life and sensation, and even thought, must necessarily result from matter alone in a state of organization; because, to the known conditions or qualities of matter, they must add that of vital susceptibility, or irritability, a property which, for all we know, may not belong to matter at all, but, on the contrary, may be a property of something superadded to it.

"If, in order," says Cuvier, "to obtain a correct idea of the essence of life, we consider it in those beings in which its effects are the most simple, we quickly perceive that it consists in the faculty possessed by certain corporeal combinations, of continuing for a time, and under a determinate form, by constantly attracting into their composition a part of surrounding substances, and rendering to the elements portions of their own. Life, then, is a vortex more or less rapid, more or less complicated, the direction of which is invariable, and which always carries along with it molecules of similar kinds, into which individual particles are continually entering, and from which they are continually departing, so that the *form* of a living body is more essential to it than its *matter*."

5. Organized bodies are formed out of a few of the substances of inorganic matter.

Carbon, oxygen, hydrogen, and nitrogen, are the elements of the greater part of the animal and vegetable structure. Animal bodies are distinguished from vegetable by containing a much larger quantity of nitrogen; and hence the peculiar ammoniacal odour which animal substances exhale when burned, or otherwise decomposed. In addition to the above, the following substances also enter into the animal structure: sulphur, phosphorus, soda, potassa, lime, iron.

Combinations of these simple substances produce gelatin, albumen, fibrin, mucus, serum, oil, fat, and phosphate of lime, of which the solid and fluid parts of the body are composed.

6. These substances, however, are only recognized out of the body, or when the living action has ceased. We know not under what condition they exist while obeying vital laws. When death takes place, coagulation, fermentation, putrefaction, and all the train of chemical actions, soon reduce the mass to the dust out of which it was originally formed.

· The minute particles of the matter of which organized beings are composed, as seen by the microscope, exhibit a globular appearance. Both animal and vegetable fluids, when thus examined, present an aqueous liquid, with exceedingly minute globules floating in it. These globules also compose the solid textures.

8. A general idea of organized structures may be obtained by conceiving an exceedingly thin texture, forming a congeries of vesicles or cells, and these cells again joining to form hollow tubes, either straight, spiral, or branched into minute ramifications.

The simplest structure is that of vegetables, where innumerable minute cells and tubes traverse the whole substance of the plant, and render it porous and permeable to the air and juices which circulate through it in all directions.

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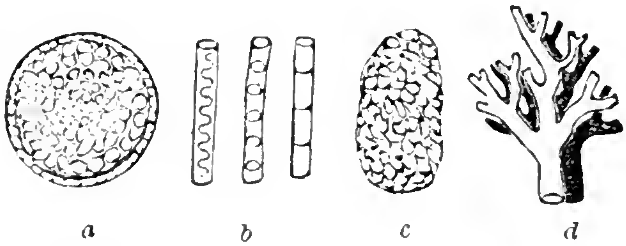

a Cross section of a piece of wood, shewing its tubular and porous nature. *b* Longitudinal view of detached vessels. *c* Cellular texture of animal. *d* Hollow ramifying branches of veins and arteries.

9. The animal structure is more complicated. A minute tissue, composed of extremely thin laminæ or plates, intimately connected together, and variously crossed and connected by fibres, forms a cellular net-work, which is the foundation of the whole animal fabric. This tissue is highly elastic, and in its simplest state porous like a sponge, but when condensed and thickened, it does not permit fluids to pass through it.

This thickened membrane forms the hollow tubes which branch out into innumerable ramifications throughout the animal frame, and through which the fluids circulate. It also lines the hollow cavities of the body, and forms sacks or pouches of various kinds.

Another variety of membrane composes the muscular fibre. The nervous substance is formed of a soft greyish matter, and of white fibrous threads.

SECTION II.

CONDITIONS NECESSARY FOR LIFE.

10. Organized bodies susceptible of vitality do not exhibit the usual manifestations of life, unless under certain conditions. These necessary conditions have been called stimuli. The direct stimuli are, moisture, air, and alimentary matter or food, all of which enter into the composition of organized bodies; and to these are added, heat, light, and electricity.

A seed of a plant, a grain of common wheat, for instance, contains an organized germ, which remains apparently dead and inactive as long as it is kept in a perfectly dry state; but whenever this grain is put into the ground, and the necessary stimuli of moisture, heat, and air, are applied, it immediately springs into life, shooting up a leaflet to the surface, and spreading its roots into the ground.

Many of the smaller animals illustrate the same circumstances. A minute worm found in diseased ears of corn may be dried and completely deprived of its juices, and in this state it will remain for months and years without shewing any signs of life; but as soon as a drop of water is put upon it, life and activity again return. Animalcules may also be thus dried and revived at pleasure. A cheese mite will remain glued to a piece of glass, without motion or any of the manifestations of life, for many months; but upon being placed on a piece of moist cheese, it will instantly revive. Eels and other fishes may be frozen into a solid mass by cold, and yet return to life when thawed.

11. A certain degree of fluidity, then, is a necessary condition of life. As all organized bodies are made up of cells, and tubes, and vessels, a free circulation of the various juices throughout this structure is necessary, both for the manifestation of living action, and for contributing to the growth and sustenance of a frame continually liable to waste and decay. Some animals have much more fluid in proportion to the solids of their bodies than others. The medusæ, and many of the lower tribes, have bodies composed of a thin, watery jelly, with only a few granular solid particles dispersed in the mass.

12. Air is essential to the life of all organized beings. The oxygen of the atmosphere is absorbed by all animals by means varying in different classes. It is directly incorporated into their blood and nutritive juices, and seems of such importance to the support of life, that in a great proportion of animals, its deprivation for even a few seconds proves fatal to existence.

Air acts as a stimulus on the whole surface of the skin, but especially on the lungs, exciting them to activity, and producing respiration.

13. Food and liquids taken into the stomach act in the first place as stimulants to the system, and, after digestion and assimilation, are converted into the organized texture of its different parts. A supply of aliment is necessary for the growth

and repair of the animal body; but that food acts in the first instance as a stimulant, is proved by the immediate refreshing effect which nourishment taken into the stomach, as a little soup or a glass of wine, has on the exhausted frame, before time could have been afforded for its digestion or conversion into a nutritious fluid. At the same time, it must be observed that, during the digestive process, and as long as the nutritious fluid circulates through the body, its stimulating properties continue. Although a supply of alimentary matter is necessary to all animals, and its daily stimulus is, for the most part, essential, yet in some, its use may be interrupted for days, weeks, and even months, with perfect impunity. The land tortoise will live for three or four months without food. Some serpents fast for several weeks. Insects in the successive stages of their metamorphoses, and hybernating animals, have long fasts of several months, in which they are entirely deprived of all sustenance.

14. A certain degree of heat is necessary for the manifestation of life. Neither plants nor animals can exist in a temperature which is permanently much above or much below 50°, or the temperate heat of Fahrenheit's thermometer. Cold-blooded animals, such as fishes, reptiles, and the mollusca, possess a temperature very little elevated above the water in which they live, nor have they the power of resisting a cold much below that of freezing, without having their vital faculties suspended. Hot-blooded animals have a temperature varying from 90° to 110°. These have a power of resisting or modifying both extremes of heat and cold; yet if intense cold be long continued, the vital functions at length give way.

A medium degree of heat, then, is a necessary condition of existence, while extremes of heat or cold are fatal to life. The young of animals can bear the extremes of heat and cold less than the full grown; while it is remarkable that the spawn or eggs of many of the inferior animals can be subjected to extremes of both with greater impunity than the parent animals.

All animals in a certain degree, but especially the higher classes of the vertebrata, have the power, by means of their respiratory functions, of producing heat within their bodies, so that they can maintain a temperature much above that of the surrounding air. Thus a hare or a field-mouse keeps up a temperature, in the freezing months of winter, at least 50° or 60° above that of the earth or snow among which it burrows.

It must be remarked, also, that the temporary application of cold acts as a powerful stimulant on the body, exciting the vessels of the skin to an increased action. After a time, however, this stimulus exhausts the powers of life, and the continued effects of extreme cold is to diminish the vital actions, induce stupor or sleep, and finally death.

15. Light also appears to be a necessary stimulus of healthy vitality. In plants, the influence of light is very apparent. Those that vegetate in the dark are sickly, and totally devoid of colour: their natural juices are not secreted, of the usual flavour, nor do such plants ever come to full maturity. Animals seem no less generally affected by light. To its influence they owe their colour, the full exercise of vision, and perhaps in a considerable degree the robust vigour of their bodies.

Fishes confined in a dark vase have been known to lose their variegated hues. Intestinal animals are almost entirely devoid of colour; and probably the pallid countenances of the inhabitants of the dark lanes and manufactories of cities are as much owing to their deprivation of light, as of the pure air and healthful exercise of the open country.

16. Electricity is an agent so universally diffused over all terrestrial bodies, and is found so uniformly present in all organized beings, as to lead us to presume that its influence as a stimulant to the animal frame must be considerable.

The electric changes in the atmosphere evidently affect all animals, from the lowest to the highest. Thus the sea anemony (*actinia*) is so sensible of atmospheric changes, contracting its tentacula more and more on the approach of storms, as to be looked on as a faithful marine barometer. The common leech is also greatly agitated before thunder or rain; so are wild-fowl and many quadrupeds. And man, too, feels his spirits depressed, and his frame unusually affected, during certain electric states of the atmosphere. Artificial electricity is also one of the most powerful stimulants of the animal system.

Although the external influence of electricity seems to be considerable on the animal frame, we are as yet ignorant whether it exercises any other more special agency.

The accumulation of electricity by some fishes, as the gymnotus, as a means of defence against enemies, has no connection with this fluid as a general stimulant.

SECTION III.

DIVERSITIES OF ANIMAL FORMS.

17. THE diversities of animal structure are very numerous, from the simplest condition of organized existence, up to the most complicated. It requires, indeed, but a very few parts simply to manifest life as we find it in the very lowest animals. A thin membrane, formed into a hollow bag, and containing a single cavity or stomach, which receives the alimentary fluid by imbibition or absorption, is one of the simplest structures manifesting life, as seen in the hydatid.

If to this we add a mouth and elastic gullet, for receiving and conducting the food into the stomach, we have another animal of very similar structure and habits, the *cysticercus*, found inhabiting the cellular tissues of other larger animals; and the *hydra* or water polype, consisting of a cylindrical, gelatinous body, which is also a hollow stomach, a mouth and tentacula, or elastic arms surrounding it, for the purpose of grasping the insects and worms on which it preys.

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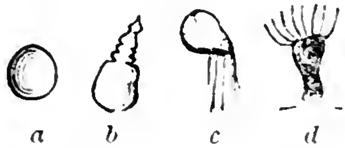

a Simple hydatid—*b* Cysticercus cellulosa—*c* Lemna gibba—*d* Hydra viridis.

As we advance in the order of being, we find superadded to this single organ of a stomach, a nervous system of ganglions and brain, a circulating system of heart and bloodvessels, a respiratory system of gills, or lungs, or branchiæ, and a muscular system, with a firm shelly or horny external covering, or a regular skeleton of bones, for all the purposes of extensive locomotion.

18. With all this diversity of structure, there is a general uniformity of plan which pervades the whole system of organized existence. This is remarkably evident throughout the several divisions of the animal kingdom; but even in the arrangements of the animal and vegetable systems, there are such remarkable coincidences, as lead us at once to conclude, that both have been constructed on one common principle.

Thus, if we compare the simplest plants and simplest animals together, we shall find a striking similarity in their structures, as well as a uniformity in their functions.

The common duck weed, fig. 2. *c.* found in abundance in ditches and pools of water, has a green seed-like body, of a cellular structure within, with numerous roots, which, floating in the water, absorb the necessary juices through their hollow tubes, and convey this food to the body of the plant, where, as in the leaves of more complicated vegetables, it is mixed with a portion of atmospheric air, and is thus rendered a nutritious fluid for the nourishment of the plant.

b is the cysticercus already described, with a body somewhat similarly shaped as the lemna ; instead of roots, it has one tube, the esophagus, opening by a mouth through which it absorbs the fluid in which it floats, and converts it by a process of assimilation into its proper nourishment.

Even in the more complicated classes of vegetables and animals, though the means are different, the plan is still similar.

Thus, the higher animals and plants resemble each other in having the following organs performing similar functions.

IN A PLANT.	IN AN ANIMAL.
The root,	The stomach,
vessels of the stem,	arteries and veins,
leaves,	lungs,
ovary.	uterus.

19. In the animal kingdom, the multiplicity of species, and the myriads of existing beings, are no less objects of our astonishment.

Of vertebrated animals, at least 12,000 distinct species have been recognized. Of mollusca not less than 6000. Of articulated animals upwards of 100,000. Of zoophytes and infusory animals, several thousands have been enumerated.

To this list we may probably add at least one-third more of the inferior species yet unknown or undescribed. When we consider that many of these tribes are most prolific, some species producing a million in one season, the actual amount of animal life existing at one time on the face of the earth must be immense. We cannot turn our eyes to any part of nature that is not teeming with life : the earth, the ocean, and the air, swarm with their respective myriads ; and if we call to the aid of our limited vision, the powers of the microscope, we shall find every drop of fluid a little world, swarming with inhabitants, all active and busy, and apparently full of enjoyment. Even the bodies of the larger animals want not their respective parasites, both without and within, and thus being is heaped and crowded upon being.

20. Although we thus find an infinite diversity of kinds, each differing from the other, some widely, and others by almost imperceptible shades, yet nature, when not interfered with by man, preserves among all these the most rigid distinctions, so that we find no blending or confusion of species. Had it been otherwise, there would have been no end to the divergence and monstrosities of forms.

There are also many wise provisions and adjustments for the preservation of the different races. Thus animals of prey produce much fewer young than those that are liable to be preyed upon. The eagle and the hawk bring forth only two or three young in a season, whereas the rabbit, the partridge, and the smaller birds, are very prolific. The species of carnivorous quadrupeds, as the lion and tiger, are few and thinly scattered, while those of the graminivorous races are numerous and abundant.

Graminivorous animals produce their young early in spring, in order that they may have a supply of green and tender herbs; and the same appropriate period of production with regard to food takes place with all other animals. The stated proportions of males and females, too, is regulated by a nice and invariable adjustment; for there is never found, either among animals or man, an undue excess or deficiency of either sex.

21. The animal kingdom has been compared to a great chain, portioned out into several leading divisions, and these again made up of many links. Now, although there is not found that continuous and uninterrupted passing of one link into the other, which has been thus imagined; but, on the contrary, there appears in many cases considerable blanks, and according to some theories, as if the great chain of being was composed of circular groups, returning into each other again and again; yet even amid all the apparent diversity, the leading principle of all the various organs, and their functions, is preserved throughout. Thus, amid infinite diversity of apparatus, the digestive, the respiratory, the circulating, and absorbent functions, all lead to the same results throughout the whole; and

the muscular and nervous systems, though progressive, are all strictly upon one uniform plan.

If we examine the details of structure more minutely, we shall find these resemblances in many instances very striking. In vertebrated animals, or those possessing a regular skeleton, comprehending fish, reptiles, birds, quadrupeds, &c. there is great diversity of external appearance, and yet a singular uniformity of the bones composing the skeleton prevails. Thus, in all this great division, we have the distinguishing characteristic of a vertebral column forming the spine.

To this column, in its simplest state, as in serpents, we have gradually added the upper and lower limbs. The fins of fishes becoming the wings and legs of birds; the wings of birds passing into the fore legs of animals; and these again into the hands of man. Then, if we go more into detail, we find that the paddles of the whale have nearly the same number of bones, with a similar form to those of the human hand. The fore paws of the mole are exceedingly like the hands of man — in the turtle there is a near resemblance to the human thumb. There are the same number of bones in the neck of the camelopard, the seal, and in man, and the fore paws of the seal, the claws of the bat, and the human hand, though formed for different uses and different elements, are in structure nearly alike. The orbit of the eye, too, in all the classes of the vertebrata, is formed by a junction of the same seven bones of the head and face, which are common to the whole. Viewed externally, the turtle and the tortoise would appear animals totally different from the other vertebrata, but internally they possess a true skeleton, to which the outward shell is superadded.

SECTION IV.

ORGANS AND FUNCTIONS OF ANIMALS.

22. Viewing the animal body as a machine, it may be justly pronounced as infinitely superior to the most elaborate contrivances of human invention. It has not only a most perfect mechanism, but, unlike all human machinery, it generates its own power, supplies its own waste, repairs its damaged structure, generates its own heat, enlarges its dimensions, and

moreover produces from its substance other new forms of a similar structure with itself.

The various functions of the animal body may be classified thus :—

	Functions.	Organs.
NUTRITIVE,	Digestion and assimilation.	Stomach, liver, &c.—intestines—lacteal vessels—glands.
	Respiration.	Spiracles—gills—lungs.
	Circulation.	Dorsal vessel—single and double heart—arteries—veins.
	Absorption.	Absorbent vessels and glands.
REPRODUCTIVE,	Generation.	From any part of the trunk of the body in gemmiparous animals. Ovaries—uterus.
SENSITIVE OR RELATIVE.	Voluntary motion.	Muscles—tendons—bones—horny and crustaceous sheaths.
	Sensation. Instinct. Reason.	Nerves—ganglions—brain.

23. For performing these functions, various organs are required. In the lowest scale of animals, the organs are extremely simple, and the vital functions performed are few. As we ascend in the scale, other organs are successively added, till at last we arrive at the top of the scale, where they are all present.

This diversity of structure affords the most scientific means of arranging and classifying animals, and is the basis of all modern zoological systems.

Thus, in the four great divisions of the animal kingdom, the arrangement proceeds, from the simplest structure up to the most complex, in the following manner :—

ZOOPHYTA.	Stomach, or cavity in gelatinous pulp—mouth—tentacula—skin—two senses.	Irritability—sensation.
INSECTA.	Stomach—mouth, &c.—dorsal vessel—spiracles—brain—ganglions—skin—muscles—external horny and shelly covering—three or four senses.	Instinct well developed.
MOLLUSCA.	Stomach—heart—blood-vessels—brain—nerves—lungs—muscles—skin—shelly covering—two to three senses.	Instinct moderately developed.
VERTEBRATA,	Stomach—mouth—teeth, &c.—heart—arteries—veins—lungs—gills—brain, and complete nervous system—internal bony skeleton—external covering of hair, wool, feathers, &c.—the five senses.	Instinct highly developed—passions—sympathies—in man reason.

SECTION V.

NUTRITIVE ORGANS.

24. The Stomach. — We have seen that the stomach is the first and only organ which is perfectly developed in the simplest class of animals. This was a necessary provision, as the growth and repair of the body depend on the digestion and assimilation of food taken into this organ. A stomach, then, of some kind or other, may be said to be common to all animals. It is true, in the very lowest class there are scarcely indications even of this organ ; some of the gelatinous forms supposed to possess animal vitality exhibiting only a porous mass, where the nutritious fluids are probably imbibed as into a sponge.

The hydatid, the hydra, and all animals above this class, however, possess proper stomachs.

The stomach is generally a simple sack, of a round or oblong shape, with an opening at both ends, one attached to the gullet, or *esophageal* end, the other called the *pyloric*, forming the commencement of the intestines. The outer covering of the stomach is a muscular membrane, the inner is called the villous coat. This latter is studded with numerous villi or vessels, having the appearance of a piece of velvet ; it is of a pink colour ; and from the mouths of these vessels is poured out the gastric juice, the chief agent in digestion.

25. The gastric juice is a clear, odourless, and almost tasteless fluid, which is constantly secreted in the vessels of the stomach, and which is retained in these vessels till the food is swallowed.

After the food has been prepared by mastication in the mouth, or by other means has been reduced to a soft pulp, it is forced by the muscular contraction of the gullet into the stomach. A certain quantity of fluid is generally taken into the stomach along with the more solid food, the greater part of this is almost directly absorbed by the blood-vessels, and as much only is left as forms the aliment into a thin pulp. The gastric vessels being now stimulated by the contact of the food, pour out their fluid upon the mass, which is gradually dissolved. To aid this process, the muscular coats of the stomach successively contract, and thus turn over and over the mass till every particle of it has come into contact with the dissolving fluid. A greyish paste is now produced called *chyme*. The action of the gastric juice is strictly chemical. It completely changes the nature of the food; and whether this has been animal or vegetable, or a mixture of both, the properties of the chyme are nearly, if not altogether, the same. The gastric juice varies in different animals. In those which feed on vegetable matter, it dissolves these substances only, whereas grain and vegetables pass through the stomach of a carnivorous animal, without undergoing any change.

The gastric juice, in the healthy state of the stomach, prevents fermentation, and corrects any putridity of the food. It has this singular property, too, that although it readily dissolves dead animal matters, and reduces them in a short time into a thin pulp, it will not act on the living fibre, as the coats of the stomach itself.

The chyme now passes out of the stomach by the pyloric orifice. Around this orifice, however, there is a valve, which immediately closes when any portion of undigested food attempts to pass the barrier, and a contraction of the lower part of the stomach throws back this portion to the place of digestion, while the digested chyme gains at all times a ready exit. The chyme, after having been mixed with the bile and the pancreatic juice, which are both poured into it from their respective ducts, that enter into the duodenum, or upper part of the intestine, then becomes *chyle*, a white cream-looking fluid, which, being collected by numerous lacteal vessels, opening with minute mouths on the inner coat of the intestines, is at last poured by one large duct into the circulating system. (32.)

26. In carnivorous animals, the stomach is a simple bag of moderate proportional size, the intestines being simple, and of moderate length.

In graminivorous animals, the stomach is large, or there are four stomachs, some of which are formed into numerous cells or folds, and the intestines are also long and complicated.

In granivorous birds, there is a crop or preparatory stomach and gizzard. In omnivorous animals, the stomach and intestines are of a medium size.

The reason of these arrangements is, that animal food is of easier and quicker digestion than vegetable: the latter requiring nearly double the time to pass through the different stages of digestion before it is converted into chyle. An animal diet affords the greatest concentration of muscular power. Vegetable food is reckoned lighter and less stimulating.

27. The mouth and teeth are intimately connected with digestion. A great proportion of the vertebrated animals are furnished with teeth, and these are particularly indicative of the classes to which the individuals belong. Carnivorous animals have long, sharp, pointed teeth; graminivorous animals flat round ones.

There are four forms of teeth generally met with: the incisors, situated in front of the jaw; the canine or dog teeth on each side; the bicuspidati and the molares towards the back.

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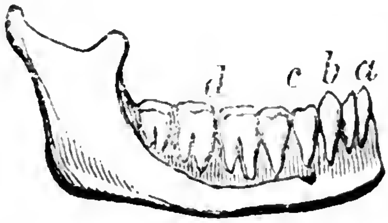

a incisors—*b* cuspidati or canine—*c* bicuspidati—*d* molares.

As the teeth form important characteristics of many species of animals, their relative numbers and positions in both jaws are designated thus:

Incisors, ...	$\frac{4}{4}$
Canine, ...	$\frac{1-1}{1-1}$
Molar, ...	$\frac{5-5}{5-5}$

The upper and lower numbers indicating the upper and lower jaw.

In the mouth are situated the salivary glands, that secrete the saliva or fluid which assists in mastication.

Birds are destitute of teeth, but have a hard, horny bill instead. Insects have palpi or horny lips. Some crustaceous animals, as the crab and lobster, have teeth at the entrance of their stomachs.

28. The sensation of hunger is an uneasy feeling, arising either from the stimulating effects of the gastric juice on the nerves of the stomach, or from an unexcited condition of the same nerves, arising from the want of the natural stimulus of food or chyme. Surprise, grief, and other affections of the mind, interrupt digestion, and allay the feeling of hunger from their effects on the nervous system.

Thirst is generally caused by a deficiency of fluid in the stomach or blood-vessels, or from salt or other stimulants taken into the stomach; yet it does not always arise from this, but rather from some condition of the nerves of the throat or stomach. A little tea, or a spoonful of acidulated fluid, or simply chewing a piece of wood, or other hard substance, and promoting a flow of saliva, will often relieve thirst, when large draughts of water will fail to do so.

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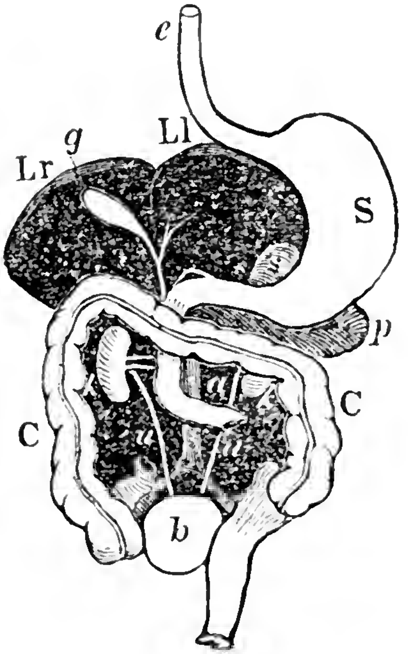

S the stomach, a little displaced from its natural position. *e* the esophagus. *L* the liver, divided into the right and left lobes, *L r*, *L l*. *g* the gall bladder, its duct seen joining the hepatic duct, and both entering by a common duct, into the upper part of the intestines. *p* the pancreas, with its duct, near the bile vessels. *s* the spleen. *C C* the colon, or large intestine. *k k* the kidneys, with the ureters, *u u*, passing to the bladder, *b*. *a* is the aorta. In this diagram the ileum or small intestines are removed.

29. THE LIVER, the purpose of which is to secrete bile, is an important organ in the process of assimilation. This organ, or some equivalent, is found in the greater proportion of animated beings; indeed, throughout the whole, with the exception of the very simplest. The biliary organs are also generally large in proportion to the other viscera. In man and the mammalia, the liver occupies the right side of the body, fig. 4. It is divided into two lobes, the left overlapping the stomach. It is of a convex form above, and concave below; of considerable thickness behind, and then passing gradually into a thin edge in front. The colour is dark brown.

A large vein, the *Vena porta*, collecting the blood from the intestines, enters the liver, and there spreads out into numerous branches. It is also supplied with arterial blood by the hepatic artery. The minute branches of the portal vein form, throughout the substance of the liver, numerous lobules or little networks, along with the minute branches of the artery and vein.

From these the bile is secreted, which is afterwards collected into the gall-bladder and ducts.

On the under edge of the right lobe is situated the gall-bladder, a duct from which passes onward to join another from the liver, while this common duct terminates in the duodenum, or upper part of the intestinal canal, immediately behind the pyloric extremity of the stomach. Bile is a greenish-coloured bitter fluid, having alkaline qualities, and containing resin and carbon. Its admixture with the newly-formed chyme converts this fluid into chyle.

30. The *Pancreas*, or sweetbread, lies behind the stomach. This gland secretes a fluid like the saliva, and pours it into the duodenum by a duct which enters near the common bile duct.

31. The spleen is a gland on the left of, and behind the stomach, the use of which in the animal economy is not sufficiently ascertained.

32. The lacteal vessels arise from the inner coat of the intestines, by very minute mouths, and in great numbers. They join together into knots or glands; larger vessels proceed from them, and these again unite into one trunk of considerable size, called the thoracic duct, which, passing up by the side of the aorta, at last joins the left subclavian vein, under the left arm.

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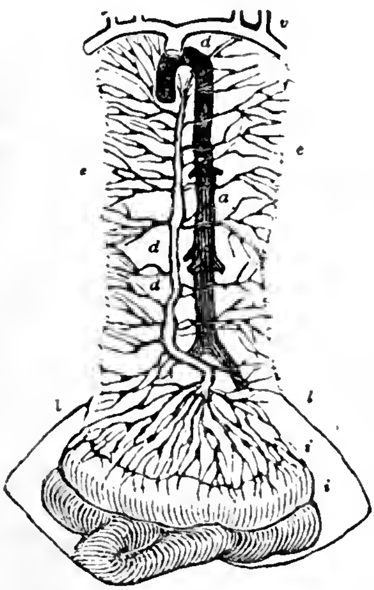

i i a portion of the ileum. *l l* lymphatic vessels. *d d* thoracic duct. *v* left subclavian vein. *e, e,* absorbents. *a* the aorta.

The use of these lacteal vessels is to take up the chyle as it is propelled forwards through the intestines, by a successive contraction of their muscular coats. The greater part of the chyle is thus taken up in the ileum or small intestines; those portions of the food which are unfit for nourishment, and the remainder of the bile and other fluids not required in assimilation, being carried out of the system by means of the larger intestines.

The chyle or nutritious fluid, having been poured into the blood by the thoracic duct, has to pass through the lungs to be aerated or combined with oxygen, when it becomes true blood, and is circulated to every part of the body, giving off new particles to each of its tissues and fabrics, — thus depositing bone, muscle, cartilage, hair, nails, or nervous matter, where it is required. It is thus that additional matter is furnished to the body, whereby it grows and increases; and thus, when wounds are inflicted, or part of the flesh cut out, the injuries are carefully and speedily repaired.

33. The length of the intestines in man is about six times the length of the body, or thirty to thirty-six feet. In carnivorous animals, they are somewhat less than this proportion; while in graminivorous animals, they are at least ten times the length of their bodies.

34. The superfluous fluids taken into the stomach, and otherwise absorbed into the blood, together with various salts, are drained off by means of the *Kidneys*, (fig. 4, *k k*) situated in the loins, into which two bloodvessels enter, while a small vessel, the ureter, (*u u*) passes from each to the bladder for the conveyance of the urine.

35. Respiration. An admixture of oxygen, and probably a portion of the nitrogen of the atmosphere, with the animal fluids, is indispensable to life, as well as a free exit to the excess of carbonic acid formed in the system. Between this constant interchange of gases and the animal fluids, as connected with life, there seems to be somewhat of the same resemblance as the union of oxygen and carbon in the phenomena of combustion.

In a great proportion of animals, and especially in the higher orders, air seems the most indispensable stimulus of existence, the deprivation of it for a few minutes, or even seconds, generally proving fatal.

There are various means by which this combination and interchange take place among animals. By simple absorption through the porous skin, as in the lowest animals; by spiracles, as in insects; by branchiæ and gills, as in fishes and aquatic mollusca; by lungs, as in the vertebrata.

In man and the mammalia, the lungs occupy the upper part of the chest, one half on the right, the other on the left, with the heart and its great vessels in the middle. They are composed of innumerable cells, over which minute branches of bloodvessels spread like a fine net-work. When collapsed, they are of a dark purple colour; but when the cells are filled with air, they become of a lighter hue. Every time an inspiration is made, the cells are filled with air, when the bulk of the lungs increases, so that they nearly fill the cavity of the chest. An expiration empties them, when they again collapse. The muscles used in breathing are those between the ribs, called intercostal; and the diaphragm, a large muscle which entirely separates the chest from the abdomen, and which extends from the back bone and ribs to the front of the chest or sternum.

The trachea, a cartilaginous tube, forms the passage between the lungs and the throat, and opens into the same cavity as the gullet, or tube leading to the stomach. To prevent particles of food or drink from passing down into the lungs, there is a valve, called epiglottis, which shuts accurately over the trachea every time a mouthful of any thing is swallowed.

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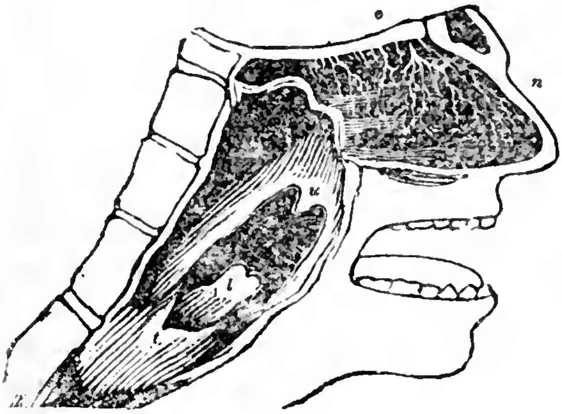

This cut represents a section of the pharynx, or the throat immediately behind the mouth. The gullet or passage to the stomach lies behind the trachea, *t*, and may be considered as the direct continuation of the pharynx and mouth. The windpipe or tube to the lungs opens into the throat as at *t*. *l* is the valve or epiglottis. *u* is the uvula or little tongue hanging from the roof of the palate, immediately above is the opening into the nose.

So accurate is this valve in its office, that it never, except from some awkward position of the body, neglects its duty. When any substance does enter the trachea, violent coughing and spasmodic action of the muscles throw it out again.

36. THE CIRCULATION in the lower animals is carried on through the interstices of their cellular structure, or by simple tubes or vessels; in the more perfect, by means of a heart and bloodvessels, the arteries carrying the blood from the heart through the body, while the veins return this fluid again to the heart.

The simplest circulation is that performed by a single heart, or one having only two divisions. Of this kind is the circulation of mollusca and fishes. A hollow cavity, or auricle, receives the venous blood from the extremities; from this cavity it passes into another, the ventricle; by successive contractions of this muscular cavity it is sent to the gills, and from thence it flows by arterial vessels throughout the body, to be again returned by the veins.

The heart of the mammalia is double, containing a right half for the reception of venous blood, and for sending this into the lungs, and a left half for the reception of arterial blood, which comes purified from the lungs, and is propelled through the aorta, and its ramifications of arteries, into all parts of the body.

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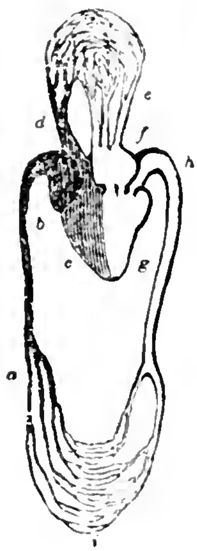
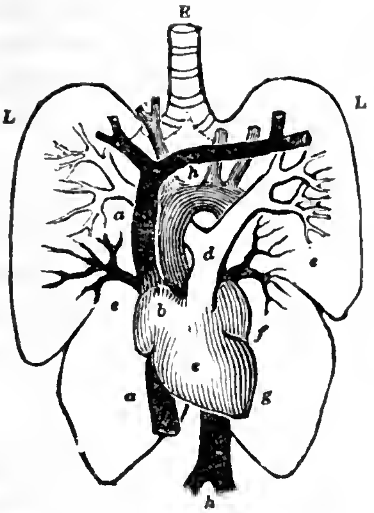


This diagram will simplify the explanation of the double circulation. The right side of the heart, with its accompanying venous vessels, is of a dark colour; the left side, containing the arterial system, is white. *a* is the vein carrying the blood into the right auricle, *b*. From this cavity it is propelled into the right ventricle, *c*; and from thence, by the pulmonary vessel, *d*, it is made to circulate through the lungs. The vessels, *e*, return the purified and now florid blood from the lungs into the left auricle, *f*; from thence it is sent into the left ventricle, *g*; and from this cavity it is propelled into the aorta, *h*, which circulates it over the whole body; and then, by numerous minute vessels, joining the veins, it returns again to the heart.

The heart is a thick muscular mass, having two halves joined together, each half containing two cavities, the right auricle and right ventricle, the left auricle and left ventricle. Its position with regard to the lungs is seen in the annexed cut.

No. 8.



E esophagus. L L lungs divided into lobes. *a a* venæ cavæ. *b* right auricle. *c* right ventricle. *d* pulmonary arteries, ramifying in the lungs. *e e* pulmonary veins, returning the arterial blood to the left auricle *f*. *g* left ventricle. *h* aorta, forming an arch, giving off arteries to the head and arms, and then descending to supply the lower extremities *h*.

The two venæ cavæ which collect the whole venous blood of the upper and lower parts of the body, open into the right auricle. From the right auricle is a passage into the right ventricle, and from this ventricle arises a large vessel which carries the venous blood to the lungs. Into the left auricle vessels open, carrying the arterial bright blood back from the lungs; then there is a passage from this auricle into the left ventricle, and from the ventricle arises the aorta or great artery of the body, which carries out the arterial blood. It is by the sudden and strong contraction of the muscles of the heart, that the blood is thus propelled; and it will also be seen, that there are four distinct and separate contractions of the cavities. Without some suitable contrivance, the blood during these contractions would flow from one cavity to another, without any regularity, and regurgitate from one to the other. But to obviate this, there are valves placed at the entrance of each of these cavities, of a beautiful structure, which accurately close over the orifices when the blood attempts to regurgitate, but which open again to let the proper current from the cavity pass onwards. These valves are seen, fig. 7.

37. The circulating process connected with respiration is this: The venous blood collected from all parts of the body, of a dark purple colour, and charged with carbonic acid gas, is received into the right auricle, and is from thence transmitted into the right ventricle. The right ventricle now contracts and discharges its contents into the pulmonary artery, which

goes to the lungs, the valve in the opening between the ventricle and auricle shutting, and preventing the blood from flowing back into the auricle. The venous blood, on arriving in the lungs, is spread over the surface of the numerous cells by means of the minute branches of the arteries, an inspiration of air into the lungs takes place through the thin membrane of the cells, the carbonic acid in the venous blood is thrown off, and an equivalent quantity of oxygen is absorbed. The blood immediately changes from a dark purple to a bright scarlet, and the air expired from the lungs is now found to have lost a portion of oxygen, and to have obtained the same proportion of carbonic acid gas. The oxygenized blood now returns to the left auricle of the heart; from this a sudden contraction forces it into the left ventricle; and a contraction of the left ventricle, the passage to the auricle being closed by a valve, sends it into the aorta in a flowing stream, from whence, partly by the original impulse of the heart, but chiefly by a contractile power of the muscular coats of the arteries, it flows in regular pulsations through innumerable ramifications to every part of the body. The minute branches of the arteries either join into, or meet in some way, the equally minute branches of the veins; and these latter, in a slower current, and with no perceptible pulsations, carry back the now darkened and carbonated stream to the left auricle of the heart, from whence, after aëration in the lungs, it flows out again in never-ceasing courses from the heart.

The veins are of larger capacity than the arteries, but less muscular in their coats. Those veins near the surface, and especially in the extremities, are furnished with numerous valves, to prevent the regurgitation of the blood. In the arteries it will be perceived, from the foregoing description, that the blood flows from the heart outwards to the extremities; in the veins the blood flows from the extremities to the heart.

38. The frequency of the heart's pulsations differs in different animals, and in individuals according to age. In large animals, the circulation is usually slower than in small; young animals have a quicker circulation than old.

The pulsation of a child varies from 100 to 120 beats in a minute; that of a grown up man from 65 to 75 beats.

So perfect and durable is the muscular powers of the heart, that it unceasingly pulsates throughout a long life, from the first moment of birth to the last pang of death. This regular action, too, is happily made independent of the will, or of any of those accidents or interruptions to which, under human guidance, it would invariably be subject.

39. The respiratory and circulating functions are also the source of animal heat. It has already been stated, that all animals generate and maintain a temperature higher than that of the surrounding media. This is particularly the case in those animals with complete respiratory organs.

The cause of animal heat seems to be as follows:—The oxygen absorbed by the blood in the lungs in passing through the arterial vessels combines with carbon to form carbonic acid, and during this combination, gives out a portion of its latent caloric. This increase of heat does not appear to be made at once in the lungs, but the caloric seems to be gradually evolved throughout the whole extent of the circulating system.

Every inspiration we make, then, and while we interchange a quantity of carbonic acid for oxygen, we take in a portion of latent coloric, which is gradually evolved as the arterial blood passes into venous.

The more perfect and frequent the respiratory functions, therefore, the greater the accumulation of animal heat. And thus the want of due exercise, by lessening the respiratory efforts, the slower respiration in sleep, and the debilitating effects of disease, all tend to diminish the natural heat of the body.

A healthy person makes, on an average, twenty inspirations in a minute. The quantity of oxygen consumed in the same space amounts to about thirty-one cubic inches.

40. The Blood, or great nourishing fluid of the body, consists of *serum*, a thin watery substance like whey, and *coagulum*, or gelatinous matter, containing minute red particles of a spherical form. While circulating in the living body, it is perfectly fluid; but, when exposed to the air, and removed from the bloodvessels, it quickly coagulates, and separates into the three parts just mentioned.

In blood is contained all the ingredients which enter into the composition of animal bodies. In several classes of animals, the colouring matter of the blood is wanting; hence the division into white and red blooded. In very minute bloodvessels, as those of the eye, the colourless part of the blood alone circulates. When inflammation enlarges those vessels, however, they admit red particles.

41. SECRETION and DEPOSITION is effected, either directly from the mouths of arteries, or from glands. Glands are formed of a congeries of minute arteries, veins, and nerves, rolled up, as it were, together, and intimately connected with each other. Here the particular substance is secreted, and a duct leads from the gland to convey the secretion to where it is required. Of this nature are the glands of the liver, pancreas, kidneys, &c.

42. The ABSORBENT system consists of a series of minute tubes, which traverse the whole body, and are found entering into every cavity, and pervading every membrane and tissue. The branches of these minute tubes often join, and form small glands, which, when diseased or obstructed, are felt like small peas under the skin. Innumerable small branches of the absorbents open under the skin, and into the cavities of the body, while the deeper seated combine to form larger trunks, which join the thoracic duct and bloodvessels. (See fig. 5, *e e*.)

The absorbent system may be said to be in direct opposition to the assimilative. The office of these numerous and minute vessels is to take up both the solids and fluids of the body, by what is called absorption, and to throw them off by exhalation and perspiration, or to return a portion of them into the bloodvessels, to be again incorporated into the system. The waste produced by the incessant action of these vessels is so considerable, that a human body loses two or three pounds in the course of a day.

Thus, during disease, a muscular and fat person will, in two or three weeks, be reduced to almost a third of his former weight by absorption. Hibernating animals, that pass several months of winter in a state of torpidity, without feeding, are also thus reduced from a condition of plumpness to mere skeletons. This is the case with some species of polar bears; with the hedge-hog, the badger, and others.

43. Not only are the fluids and soft parts of the body thus absorbed, but even the bones, tendons, and toughest membranes are gradually broken down, and taken up particle by particle, so that the entire substance of the animal frame is changed and renewed many times in the course of a lifetime.

The growth of hair, nails, claws, and horns, and the repeated abrasions and renewals of the external skin, are familiar examples of this change; and with the exception of the teeth, which, after one renewal, remain permanent, there is no other fabric of the body which is not constantly undergoing progressive decay and restoration.

44. The absorbents not only exhale vapour from the body, but also take in a quantity of watery fluid when the state of the system requires it. This fluid, along with the absorbed juices of the body, is poured into the circulation in the form of lymph. A modification of action also takes place between the absorbent, the exhalent, and the urinary vessels, by which a regular balance of the fluids of the body is produced.

When the digestive and assimilating functions give way, while the absorbents still continue in activity, gradual dissolution ensues, and thus life may be said to be extinguished by the activity of the absorbing system becoming greater than that of the conservative. The flame of existence goes out for want of a supply of the material of combustion.

45. From this excess of action of the absorbents arises the tendency of all parts of the body after a time to become hard, stiff, and solidified; and thus gradual decay may be so far accounted for.

We are totally ignorant, however, of the peculiar law of vitality, which limits the duration of life, either in the species generally, or in the individual. An animal in the prime of life, and in full health, appears to be possessed of the properties of an indefinite existence. It is true, a continued waste is going on in its system, but it has also, to all appearance, within itself the means of constant renovation.

SECTION VI.

REPRODUCTION.

46. Organized beings not only increase their own growth, and repair the continual waste of their substance, but they also produce other beings similar to themselves; and thus a continued chain of offspring succeeds from the first of each created species to the last.

In many plants, a slip or portion of the organized substance of the parent plant put into the ground, immediately begins to assume an independent life. Roots shoot out and absorb moisture from the soil, while new buds and leaves spring from the stem.

In other cases, a seed is formed from the plant which contains the organic germ of the future vegetable. It seems to be a universal law throughout all organized beings, that every species propagates its own peculiar kind, and no other, — *equivocal* generation, or an animal of one species springing from an animal of a different species, having no confirmation in facts, although theories of this kind are not without supporters. *Spontaneous* generation, or the idea that plants and animals could be produced without parents or seeds, is now also universally exploded.

47. The simplest animals are, like plants, propagated by slips from the parent, by what is termed gemmiparous production.

The polype is an example of this. From the body of this animal a small granulation is seen to protrude, which gradually acquires tentacula and a mouth. Thus attached to the parent the young continues to feed for some time, until, having acquired its full development, it drops off, and becomes a distinct animal. Sometimes other young shoot out from this one before it has dropped off. These polypes, as well as the actinia, the common earthworm, and several other animals, may be artificially divided, and each part will become a distinct animal.

48. Animals higher in the scale of organization, produce spawn or ova, which, like the seeds of plants, contain the organized germ of the species.

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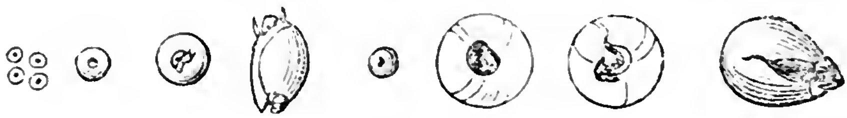


a *b* *c* *d* *e* *f* *g* *h*

The Physa fontinalis, a small shell snail, common in our ditches, deposits its spawn on the leaves and stems of plants. This spawn *a* consists of a gelatinous mass, in which are seen minute black spots or ova. In a few days, the influence of heat and air excite these ova to life, and they gradually enlarge and become visible as distinct vesicles *b*, containing the embryo within, which has now acquired a revolving motion. A few days more shew the animal with its shell distinctly formed *c*; and at last, the embryo *d*, being perfect, bursts its enveloping membrane, and makes its escape.

The spawn of the frog exhibits a progressive change of form of the young animal. At first, it is simply a circular black ovum contained in a gelatinous mass *e*. After a few weeks, it acquires a head, body, and tail, *f g h*, and bursting its enveloping membrane, becomes a tadpole. In this condition it is an aquatic animal, with gills on each side of its head. A few weeks more, these gills are changed into lungs; a pair of fore legs grow out from the chest, then a pair of hind legs follow, while the tail is absorbed; and at last the perfect frog leaves the water, and becomes a terrestrial inhabitant.

Birds are a higher class of oviparous animals. An egg consists of an external shell, formed of carbonate of lime. This contains the white or albuminous matter, within two folds of thin membrane, which separate at the round end, and embrace within their folds a quantity of atmospheric air. Within the albuminous matter is the red part or yolk. The germ of the future chick floats upon the outside of the yolk bag, and is attached in such a way as always to occupy the uppermost part of the egg, whatever way this last may be placed, so that it may be freely exposed to the maternal heat. The chick of the domestic fowl is developed in this manner:

No. 9.

a *b* *c* *d*

On the second day of incubation, an elongated body *a* somewhat bent, swelled out at each end, and surrounded by a membrane, the amnion, becomes visible. Traces of a spinal cord running along this body are first discernible, and then, towards the end of the second day, several small red points or spots, the rudiments of the heart and bloodvessels. On the third day, the heart, in form of a curved canal, is visible, and pulsation commences *b*. The spinal column, ribs, brain, and eyes, now also can be distinguished. The latter are seen as two large black points. On the fourth day, the stomach and intestinal canal are visible. The chorion or umbilical membrane now also assumes a beautiful appearance, being full of bloodvessels, which go to supply nourishment to the chick. The lungs begin to be formed on the fifth day; and on the sixth, voluntary motion is perceived. On the ninth day, bone begins to be formed; and on the fourteenth, feathers appear *c*. From this period to the twenty-first, the whole substance of the egg, including the yolk, is absorbed into the body of the chick; fig. *d* shews its position in the egg. It now bursts its shell, and appears an animal perfect in its instincts, and ready to walk, eat, and perform all its functions.

49. A similar progressive development takes place in the young of the mammalia previous to their birth, the fœtus being nourished within the uterus by bloodvessels connected with the parent. The rudimentary vessels, and organs of the fœtus, are first formed double, and afterwards coalesce. It gains an accession of organs, too, and a change of their form, as it proceeds to its perfect state at birth.

A characteristic of the mammalia is, that the young are produced alive, and aftewards suckled during a certain period by milk from the teats of the mother.

SECTION VII.

ORGANS OF MOTION.

50. Besides the organs for the nourishment of the body, there are others necessary for locomotion, for procuring food, for defence, and, in the larger animals, for the support and solidity of the soft parts.

The soft and tender bodies of the lower animals are protected and supported by crustaceous and horny coverings, or by shells, scales, hard plates, or tough skins.

The *Terebella conchilega* is an instance of a soft and simple worm forming for itself a sheath of extraneous materials. This animal burrows in the sand of the sea shore, and consists of a soft body covered by a thin membrane or skin. From this skin a mucilaginous and adhesive fluid is poured out, which, entangling fragments of shells and particles of sand, forms a protecting case around it.

The caddis worms, or larvæ of the *phryganea*, a brown fly which is hatched in the water, by a similar process draw around their bodies pieces of straws and bark of trees, or the empty shells of aquatic snails, and thus form a strong sheath for their protection.

51. The crustaceous cases of the crab and lobster, and the horny rings and plates of insects, are in fact external skeletons, subservient to their protection and locomotion.

The cuttle-fish bone is the first approach to an internal skeleton.

52. A frame-work of bones, more or less complete, is common to all the vertebrata.

Bone is composed of phosphate and carbonate of lime, with animal gelatine. The earthy matter gives it solidity, the animal matter pliability. Bones are either hollow cylinders, with articulations or joints at the ends, or plates, with compact surfaces and a porous centre.

The chief parts of the skeleton are,—

The vertebral column, consisting of cervical, dorsal, and lumbar vertebræ.

The skull, placed upon this column, and resting on the first cervical vertebra, consists of the occipital, the frontal, two parietal, and two temporal bones, with the sphenoid bone forming the base, and the ethmoid part of the nose. The face is formed by the two maxillary bones, the palatal and the nasal bones, and the lower jaw.

The ribs and sternum, forming the cavity of the chest.

The Pelvis, or hollow basin, forming the lower part of the abdomen.

The superior extremities, consisting of the scapula or shoulder blade, the humerus or arm bone, the ulna and radius the two bones of the fore arm, the carpal or hand bones, and the fingers.

The inferior extremities, consisting of the femur or thigh bone, the tibia and fibula, or bones of the leg, the tarsus, or bones of the foot, the os calcis or heel bone, and the toes.

53. Ligaments connect the jointed bones together, and are tough membranes, sufficiently elastic to permit of extensive motion.

54. Muscles are composed of red fleshy fibres, which possess great elasticity, and by their contraction and elongation produce all the motions of the body.

They are either formed of single layers or fibres, all running in one direction, or of two layers placed obliquely.

Muscles are generally of a deep red colour, constituting the fleshy parts of animals; or, they are pale red, as in some birds; or entirely white, as in fishes, some reptiles, and in molluscous animals.

By muscular contractions, every voluntary motion of the animal machine is performed, as well as the involuntary motions of respiration, the circulation of the blood, the motion of the stomach and intestines, &c.

55. TENDONS are tough, fibrous bands, which serve to attach muscles to bones and ligaments. They are joined to the end of muscles like a rope, and thus form a means of communication between the muscle and the point from which it is intended to act. Tendons are most numerous about the joints, especially the larger ones, where they allow of free and unrestrained action, and yet occupy little space in situations where a large swelling muscle would be inconvenient. About the larger joints of the body, such as the knee, elbow, and shoulder, there are numerous glands which pour out an oily substance, that serves to lubricate the joints, and facilitates the play of the tendons.

56. When we consider tne various positions which the different parts of the body assume, the agility and quickness by which the most intricate movements are made, the ceaseless play of the heart, the heaving of the lungs, and the singular rapidity of articulation or speech, we need not be surprised that these muscles should be many in number, and important agents in the animal economy. There are from four to five hundred muscles in the human body. On each side of the back bone there are several layers of strong muscles, which are fixed by tendons to every projection of the numerous bones which compose the spine. These muscles keep the trunk of the body erect, and also permit of the various motions of the back. There are a number of small muscles about the face, and head, and eyes, whose various actions impart that expression to the human countenance which indicates the prevailing feelings and passions of the individual. The tongue, besides being of muscular form itself, is supplied by a number of intricate muscular fibres, which give that amazing volubility of action, by which the vast number of sounds composing language are expressed. Several are attached to the lower jaw; but two, in particular, the temporal muscles, proceed upwards through an arch, formed by a projection of the temporal bone, and are fixed to the scalp. These two muscles are the most powerful in moving the jaws in the operation of chewing the food, and are very large in several animals of prey. Another flat muscle inside the cheek is called the buccinator or trumpeter muscle, because it assists in

compressing the cheek in the act of blowing wind instruments. The chest is supplied with numerous muscles, which move the ribs upwards and downwards in the action of breathing. A large flat muscle, the diaphragm, which is attached to the spine and lower ribs, and stretches across the cavity of the chest, also contributes to respiration. The arm and hand are rolled inward and outward, by a set of muscles which are placed on both sides of the respective bones. The muscles of the fore arm are fixed to the scapula or shoulder blade at one end, and to the bone of the arm at the other. The fingers are moved by muscles situated in the fore part of the arm, and have long slender tendons by which they are attached.

No. 10.

Two beautiful provisions are here remarkable: at the wrist a circular band *a* binds down the long tendons of the hand, which would, in their various motions, otherwise start up from their places at the same time that they play freely below this ring; the other is the construction of the tendons of the fingers. There are two principal muscles which move the joints of the fingers, and two sets of tendons which are inserted, the one into the middle bones of the finger, the other into the third row of bones, or the extremities of the finger. In order to preserve their free action, and to make them lie in the most convenient manner, there is a loop or slit in the shorter tendon *b*, by which the other passes through to its insertion in the point of the finger *c*. By this means the longest and strongest muscle moves the extremities of the finger, where the greatest power is wanted.

The muscles which move the lower extremities are much of the same kind, but thicker and more powerful than those of the arms. Several large muscles are attached to the pelvis and thighs. Two thick muscles compose the calf of the leg, and are connected at the ancle by the tendon of Achilles, which is fixed to the heel bone. These muscles act powerfully in bending the leg, and in supporting the body while standing or walking. The feet and toes are moved by several long slender muscles situated in the leg, which have tendons attached to them similar to those of the arm and hand.

By the nice balancing of the muscles, and their continual exertion, man is enabled to maintain an erect attitude, contrary to the laws of gravity; and the inferior animals, to stand and assume their various positions.

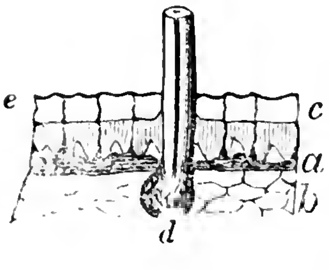
Creeping, walking, leaping, flying, swimming, are all modes of locomotion peculiar to animals.

57. The FAT contained in the cellular membranes fills up the interstices of the muscular system, and serves to render the external aspect of the body smooth and symmetrical.

It is secreted in different quantities, according to age, constitution, sex, and other circumstances, and is absorbed and redeposited at various periods. In some animals, as in hybernating quadrupeds, it seems to be stored up in seasons of plenty, to provide against periods of inactivity and inaction.

58. The SKIN is a membrane common to almost all organized beings, both plants and animals, although in the very lowest animals, such as the gelatinous polype, the flustra, &c. it is not very apparent. In all animals above these zoophytes, however, an external covering of skin is a well marked characteristic.

No. 11.



A magnified view of a piece of skin. *c* the external cuticle. *a* the cutis, with the papillæ. Between *a* and *c* the mucous net-work. *b* the cellular membrane below the cutis. *d* a hair with its root and nourishing vessels. *e* the sudorific vessels, opening on the hollow furrows of the external skin.

The skin consists of three parts. The external cuticle or scarf skin, seems to partake of the nature of a deposition, being unorganized or unfurnished with vessels, and insensible. It is variously marked by furrows, in the hollows of which are numerous minute pores, to permit the exudation of perspirable matter. On the soles of the feet, and palms of the hands, it is considerably thickened. Below the outer skin is the *rete mucosum*, or mucous net-work, an almost invisible membrane in the white variety of man, but sufficiently conspicuous in the negro. This membrane secretes a mucus variously coloured in the different varieties of mankind; in the Negro the pigment is black from containing a portion of carbon.

The *cutis, corium,* or true skin, lies below this. Unlike the cuticle, it is highly vascular, containing innumerable minute blood-vessels and nerves. It is of a bright red colour, and is acutely sensible to the touch.

The insensibility of the outer skin, constantly exposed to abrasion and the contact of hard bodies, is a no less wise provision of nature than is the extreme sensibility of the inner skin, which serves as a sensitive guardian for the protection of the vital parts beneath. The cutis is the most exquisitely sensitive membrane of the whole body, hence in wounds or in surgical operations, the greatest pain is experienced when this membrane is cut through.

Hairs, feathers, down, bristles, grow from the skin, and form the covering of various animals. All these substances are bad conductors of heat, and hence their appropriateness as coverings to animals in cold climates.

59. A HAIR (fig. 11, *d*) is a hollow tube, with a bulb or root enclosed within a capsule, into which the vessels of nutrition enter. This bulb is situated in the cellular membrane below the skin, and grows out, as it were, through both membranes. The central hollow of the hair contains the carbon, which imparts to it colour, and where this is deficient or dried up, the hair becomes grey.

60. Feathers also grow out in a similar manner. Each feather originates in a highly vascular cone, which, after having nourished the plume, becomes the quill. After the plume has been completed, the vessels shrivel and dry up in the interior of the quill.

Horns, nails, and claws are formed of the same material, (albumen,) and in a similar manner as hair.

SECTION VIII.

BRAIN AND NERVOUS SYSTEM.

61. The nervous system is the seat of sensation, by means of which animals become acquainted with the external world around them, and through the medium of which instinct and reason are manifested.

Simple organic life does not seem to require the agency of a nervous system ; at least, this system is not visibly developed in plants or the lower zoophytes.

It is very early developed, however, in the progressive scale of animal existence. In the embryo of all the more perfect animals, this system is the first to become visible as an organized structure ; and branches of nerves or ganglions go to supply all the organs of nutrition, as well as those of sense or voluntary motion. Indeed, nervous filaments of some kind or other pervade every part of the body.

62. The nervous system consists of ganglions, nerves, and brain. The nervous matter is of two kinds,—a greyish, soft, pulpy substance, and a white fibrous matter. Both are contained within sheaths of membranous tissue.

In the polype, and other gelatinous zoophytes, no distinct nervous system is visible ; but it is not improbable but that the nervous matter may be diffused among the granulated bodies which form their structure. The simplest form of nervous system is that of slender cords traversing the body, and joining in knots or ganglions. A double chain of these cords, with ganglions corresponding to each division of the animal, is seen in the common earth-worm *a*, while from these knots other minute branches are sent off to the surrounding parts of the body.

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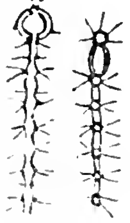

a *b*

a, ganglionic chain of common earth-worm : *b*, the same of humble bee.

In the humble bee *b*, there is an approach to the formation of a brain by an accumulation of nervous matter.

As we advance in the scale of animals, we find a spinal cord giving off nerves and ganglions, and surmounted by a cerebellum or lesser brain.

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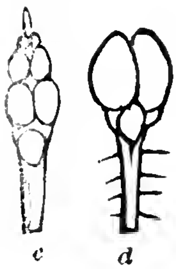

c, the brain of a fish. *d*, the brain of a bird.

63. In vertebrated animals, there is a cerebellum or lower, and a cerebrum or upper brain.

In the lower animals, the cerebrum, or brain proper, is much smaller than in those of a higher class. In man, the cerebrum, or upper brain, is much larger, in proportion to the cerebellum, than in any other animal. It has also more numerous convolutions or furrows on its surface than that of the class of monkeys or quadrupeds which approach nearest to it in structure.

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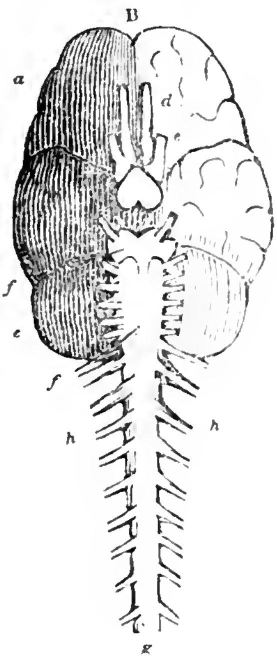

B The human brain, viewed with the base turned up. *a b*, the anterior and posterior lobes of the cerebrum. *c*, the cerebellum. *d*, the olfactory nerves. *e*, the optic nerves. *ff*, the other nerves of sense taking their origin from the upper part of the medulla oblongata, from whence also proceed the cerebro-spinal nerves. *g*, the spinal cord, from each side of which proceed two pairs of nerves, as at *h h*.

64. The cerebrum is divided into two halves or hemispheres. Each of these are marked externally by deep convolutions. The brain consists of a grey matter, which occupies the outermost portions of the hemispheres, and a white fibrous matter, which connects the whole in the centre, and then joins the spinal cord. The hemispheres have also hollow internal cavities called ventricles; one large ventricle occupies each side, and the smaller ones are common to the brain and cerebellum.

65. The cerebellum is situated behind and below the cere-

brum, and internally shews the white fibrous matter ramifying like the branches of a tree.

At the base of the brain, and at the point where it is joined by the *medulla oblongata*, or upper portion of the spinal cord, the nerves of sense take their origin, *d e f.* From this part also several branches of nerves proceed to the organs of nutrition, respiration, &c. These are called the cerebro-spinal nerves.

66. The spinal cord consists of six filaments, all included within one membranous sheath.

From the anterior portion of the cord, two pairs of nerves branch off at short intervals along its whole length, and send filaments in all directions over the body; these are the nerves of motion, *h h.* Two nerves are sent off at the same time from the posterior part of the spinal column, which accompany the others, and are the nerves of sensation.

SECTION IX.

THE ORGANS OF SENSE.

67. By means of the senses, animals become acquainted with the external world, and with the properties of bodies around them. They are five in number,—touch, taste, smell, hearing, seeing. For each of these senses there are appropriate organs, and these organs must be acted upon, more or less directly, by matter from without, before an impression is conveyed to the seat of perception.

68. All the senses are not indiscriminately bestowed upon every gradation of animals, a great proportion of the lower classes being destitute of one or more of them. Man and the more perfect animals alone are furnished with the five senses, by which they are enabled to distinguish all the qualities of bodies.

In order to have a complete knowledge of an object, every one of the senses is requisite, for each imparts some information different from the other. Thus, the sight of an apple conveys to us only the idea of a plane circle, with a surface of varied colours. The touch of this apple informs us that it is a sphere, with a certain degree of smoothness or roughness on the surface. From the sound produced by striking it, we may ascertain whether this sphere be hollow or solid within. The smell gives us the peculiar odour; and the taste another of its important properties.

69. The SENSE OF TOUCH, or feeling, may be said to be common to all animals; for this is a distinguishing characteristic of animated beings, that they possess sensation in contradistinction to the mere irritability of plants. The simplest zoophyte shrinks when a sharp body is applied to any part of its frame; and so sensitive is the common earth-worm, that it perceives the tremulous motion of the earth, withdrawing itself into its hole when an enemy approaches, and coming forth to feed when it feels the soft drops of rain pattering on the soil.

70. This sense is diffused over the whole body, though very unequally; and, indeed, in many animals which are protected by horny or crustaceous coverings, the perception of feeling in any of the external organs must be very obtuse and imperfect.

The general diffusion of a certain degree of sensibility, however, is bestowed on all animals, to warn them of danger, of the contact of opposing bodies, of extremes of heat or cold, of moisture, or of deleterious fluids. So universally spread over the surface of the body are the nerves of feeling, that one cannot touch the minutest spot with the point of a pin without exciting some of them. It is not improbable but that there are more than one set of these nerves, as the feeling of cold or heat is sometimes perceptible when the contact of sharp pointed bodies is not distinguishable.

The sense of touch resides in the cutis, the papillæ of which are formed of extremely minute arteries and branches of the nerves of sensation. (See fig. 11, *a*.) The external cuticle is itself insensible. The sense is most acute in the tips of the fingers, the lips, the face, the arm-pits, and less so on the trunk of the body, the head and joints.

A simple experiment will shew this. Take a pair of metallic compasses, and separate the points to one tenth of an inch. If you apply these to the arm or the cheek, you have the perception of only one point of contact, whereas if you apply them to the lips or the points of the fingers, the superior sensibility of these organs will distinguish two distinct points. If you separate the points of the compass an inch asunder, and draw them along the cheek from the ear to the mouth, you fancy that the points separate wider and wider as you approach the more sensitive parts, while, by reversing the operation, you have the feeling as if the compasses were gradually closing.

Nature has established a beautiful and most appropriate adjustment of the sensibility of the various structures of the body. Thus, though the external skin or cuticle is insensible, the cutis or inner skin is highly alive to all external injury. The muscles are much less so ; the tendons only become sensible when over-stretched; the bone only when inflamed or diseased; the vital organs, as the heart, lungs, brain, have very little sensibility; the membranes of the eye are exceedingly sensitive of the irritation of small particles of matter, as dust, hairs, fluids, but can bear the application of the finger without indicating any extraordinary irritability.

71. Some animals of prey have hairs or bristles projecting from their mouths, which communicate the contact of bodies to the sensitive skin : such are the whiskers of lions, cats, and dogs. Bats have a singular acuteness of touch, by which, in flying through dark passages, they can avoid projecting corners and other obstructions in their unseen course.

72. All the other senses may be said, in some degree, to be modifications of touch, as all the organs of sense are stimulated by the immediate contact of matter. Thus sapid bodies touch the tongue; odoriferous particles touch the membrane of the nose; undulations of air cause vibrations of the tympanum ; and light stimulates the nerve of vision.

73. The Sense of Taste is in general confined to the tongue, and resides in the raised papillæ, which are found covering its upper surface, especially towards the middle and point. These papillæ are formed by blood-vessels and the branches of the gustatory nerve.

In man and most of the mammalia, the tongue is the sole organ of taste. If you touch the lips, or palate, or cheek with a piece of sugar, no sensation of sweetness is perceived till you apply the tongue to the part so touched.

In many birds, in insects, and crustaceous animals, where the tongue and mouth are not formed of soft parts, but are of cartilage, horn, or shell, the sense of taste must be very imperfect, if not altogether deficient. Some animals are supposed to possess this sense in the lower parts of the esophagus, or in the stomach. As in a great proportion of the lower animals, however, this appears the only sense which could guide them in the selection of their food, taste, under some modification or other, must be one of the most universally diffused of the senses.

74. The Sense of Smell resides in the nose, or inner lining of the nostrils.

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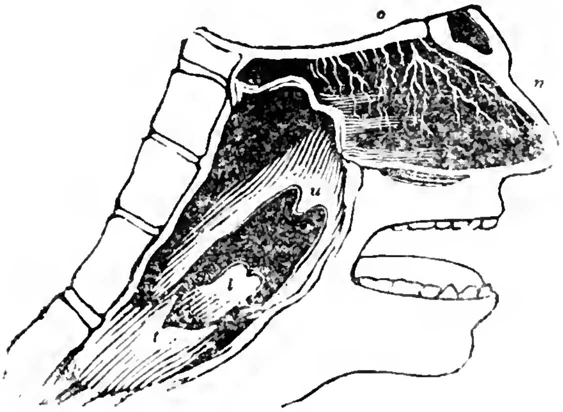

n is a section of the cavity of the nose, separated into two parts by the septum. *o* the olfactory nerve, with its branches ramifying on the inner nostrils. The cavity of the nose communicates with the mouth at *u*, where is situated the uvula or little valve, seen in the back part of the mouth, which guards this passage to the nostrils.

The internal cavities of the nose present a large extent of surface, by reason of numerous plates or divisions of the thin bones composing the organ. The surface of these plates is lined by a mucous membrane full of bloodvessels, and over which the branches of the olfactory nerve, *o o*, are distributed. Many bodies emit an effluvia or odour, which is a portion of their substance diffused in the air, in the form of exceedingly minute particles. Before an odour is perceived, it is necessary that a current of air, containing these minute particles, should pass through the nostrils, for if a person remains perfectly still, without breathing, no smell is perceptible.

75. The sense of smell is very acute in some animals, serving the important purpose of guiding them to their food, or enabling them to escape danger. Certain animals of prey, as bears, wolves, and dogs, hunt by means of their acute scent, and wild buffaloes, deer, and other herbivorous quadrupeds, smell the approach of an enemy at a great distance. and immediately provide for their safety in flight. The simpler classes of animals, as shell-fish, snails, worms, have no organ of smell, and are thus incapable of perceiving odours. In man, the sense adds to his enjoyments, and enables him to avoid poisonous food and noxious vapours, which would prove fatal to him.

76. The Sense of Hearing. The ear is the organ of hearing, and is much more complicated than the organs

hitherto enumerated. The external ear is an oval hollow, marked by several convoluted passages, for collecting and transmitting into the interior ear the undulations of the air.

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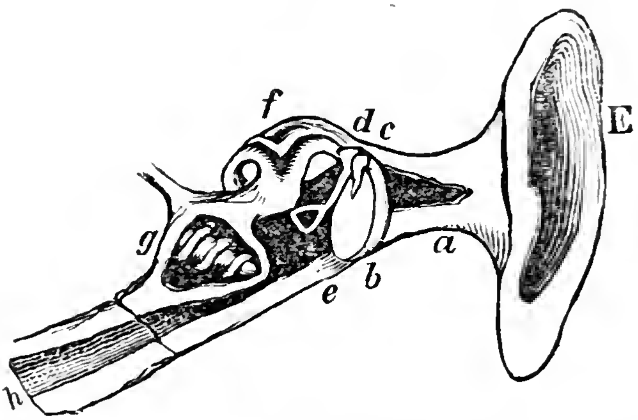


E the external ear. *a* the passage to the internal ear. *b* the membrane of the tympanum. *c d*, the small bones of the tympanum. *f* the semi-circular canals. *g* the cavity of the cochlea, and auditory nerve seen entering it above. *h* the eustachian tube leading to the mouth.

The internal parts of the ear are situated in a hollow of the temporal bone. A pasaage leads directly from the outer ear to this inner cavity. In order to prevent extraneous bodies from entering this passage, it is furnished with numerous hairs and a tough wax, which envelops dust or other bodies, and deters, by its disagreeable, bitter taste, insects from penetrating through it. Around the mouth of the inner tube, is a circular hollow, called the tympanum, over which is stretched a thin membrane or drum. Behind the tympanum the passage is still continued. Above are the hollow semi-circular canals, and a little farther onwards the cochlea, a cavity like the interior of a convoluted marine shell. These cavities contain a fluid matter, and here the branches of the auditory nerve are distributed. Four little bones are adjusted by small muscles to the margin of the tympanum, and seem to be instrumental in stretching or relaxing the membrane, to accommodate it to feeble or strong vibrations of the air, as well as to transmit these vibrations to the inner chambers of the ear. The eustachian tube forms a passage of communication between the internal ear and the mouth, its lower end opening upon the side of the cheek behind the passages to the nose. The use of this opening is to allow the exit of air from the inner cavities of the ear, and thus to permit of a free vibration of the membrane of the tympanum. Hence, in a common cold, when there is inflammation and obstruction of this cavity, deafness occurs.

We have thus an organ, curiously contrived, to collect and transmit vibrations to the sensorial nerve; the next consideration is the cause of sound.

77. All bodies, especially elastic ones, when they come into sudden contact, vibrate or move quickly backwards and forwards; this produces a wave-like motion in the air, and these waves or vibrations exciting the organ of hearing, convey to us the impression of sound. This aërial undulation may be explained by what takes place in dropping a stone into a pool of water. Immediately around the stone the water becomes agitated, and circle after circle of waves expand and roll on till they reach the margin. Thus the vibration of a piece of wood struck against a resisting body, the vibrations of stringed or wind instruments, or of the elastic membranes of the throat and mouth of animals, or the explosion of a gun, or the concussion of electric matter in the clouds, all produce an impulse in the elastic air, and become the cause of sound.

78. These successive undulations take a perceptible time to flow onwards. Sound is calculated to travel at the rate of eleven hundred feet in a second, or about one mile in four seconds; and as vision may be said to be instantaneous, the report of a gun fired at the distance of a mile, is not heard till four seconds after the flash has been perceived. Thus, too, in looking at a distant workman hammering on a stone or anvil, the report seems to be produced when the hammer is elevated in the air, at an interval of several seconds after the blow has actually been struck.

While ordinary sounds are perceptible only within a limited space, violent and extensive concussions of the atmosphere, with favourable winds, may be heard at the distance of twenty, fifty, and even one hundred miles.

Water and solid bodies, as wood, and the surface of the soil, are better conductors of sound than the air.

79. A great proportion of the lower animals are destitute of an organ of hearing; and hence we may conclude that they have no perception of sound, properly so called; yet many of these have such extreme sensibility of feeling, as to be quite alive to the aërial vibrations that give rise to sound in the higher classes.

In animals of prey, the sense of hearing is extremely acute.

In the feline species it is particularly so. In the owl the organ is very largely developed.

80. The Sense of Sight, is the most varied and splendid of the whole, and embraces a field which is only bounded by the material universe.

While the other senses are confined to bodies which come into immediate contact with us, or which exert their influence at a short distance, vision acquaints us not only with the minutest atoms which float in a drop of fluid, but also with the shapes and motions of other worlds, and other suns, which lie far beyond any conceivable limits of distance.

81. The eye is of a spherical form, and is situated in a corresponding hollow formed by the bones of the head and face.

Fig. 1. No. 16. Fig. 2.

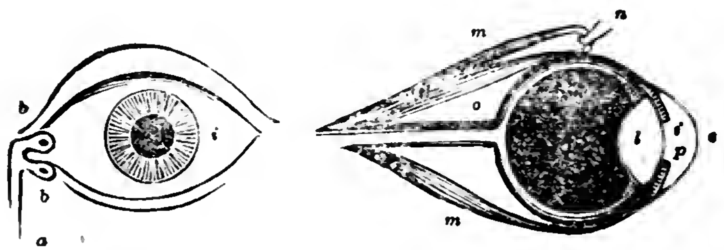


Fig. 1.—*b b*, lacrymal points, leading by the duct *a* to the nose. *i*, the lined circle the iris, the black circle the pupil.

Fig. 2.—*m m n*, muscles which move the eye-ball. *c*, cornea. *i i*, iris. *p*, the pupil. *l*, crystalline lens. *o*, optic nerve.

It is composed of three coats—the sclerotic or external coat forming the white part of the eye, the choroid or middle coat, and the retina, or fine nervous net-work, which lines the inner cavity. Three-fourths of the ball of the eye are hid within the bony socket; here, too, are placed the muscles which move it in all directions. There are six of these muscles *m m*, which produce the various movements of the eye. They are attached to the eyeball, and to the bones of the socket. One of these muscles has its tendon passing over a loop or pully in the socket, fig. 2, *n*, an evident contrivance to double up this muscle, which would otherwise be too long for the space in which it has to play, while at the same time it reverses the direction in which the muscle acts. The eyelid forms a moveable protection in front, and the eyelashes prevent the intrusion of small bodies. As the membranes of the eye require to be kept constantly moist and transparent, a gland in the upper and outer angle of the socket secretes a fluid for this purpose. After this fluid has moistened all parts of the eye, it flows into two little ducts or openings, *b b*, seen in the inner corner of each eyelid, and thus passes into the cavity of the nose by the canal *a*. When produced in excess, this fluid is called the tears.

A front view of the eye (fig. 1.) exhibits the sclerotic coat, or outer white circle; the cornea, or next circle, which is transparent, and through which is seen the iris *i*, or moveable curtain of the eye; and in the centre, the pupil or window, through which we look into the back chamber.

A side view or section of the eye (fig. 2) shews the position of the same parts. The cornea *c* is a semicircle, projecting in the middle; the membrane is quite transparent, and the fluid within is called the aqueous fluid; *i i*, is the iris. This membrane is so called because it is of various colours in different individuals. It is of a muscular structure, and is so sensible to the stimulus of light, that its fibres contract whenever luminous rays fall upon it. In this way it modifies the quantity of light which enters the eye. In a feeble light, the iris relaxes, so that the pupil *p* is greatly enlarged or dilated; in a strong light, it contracts and diminishes the circular opening of the pupil to a mere point.

Behind the iris is seen the crystalline lens *l*, enclosed within a capsule or case, which is kept in its position by the ciliary processes. The lens is doubly convex, with the greater convexity behind. It is filled with a dense fluid, called the crystalline humour. The structure of the lens is lamellar, many thousand exceedingly thin plates entering into its composition. This structure may be seen in the eye of a fish after it has been boiled. Behind the lens is the posterior chamber of the eye, occupying the greater part of the ball, and filled with the vitreous humour, a dense transparent fluid. The optic nerve *o* enters the back chamber of the eye, and spreads out into an extremely fine net-work, upon the retina or inner lining. Below this, a layer of carbon forms a black pigment, which prevents all reflection of the rays in this inner chamber.

82. The theory of vision is this: Light falling in direct rays from the sun is reflected from the surface of bodies, and

thus comes to the eye in straight lines from every point of the objects before us. The eye collects these rays; and they first enter the cornea, from whence they pass through the central opening of the iris, subject to the control of this highly sensitive organ. Arriving at the lens, they are refracted by its convex surface, and passing through the vitreous humour, are conveyed into a focus on the retina or back chamber of the eye. Here a minute image of the object before the eye is painted, and thus the impression is conveyed by the optic nerve to the sensorium. There are two circumstances which may here be noticed. The picture on the retina is reversed, yet we perceive it in its natural position; and there are two images, one on each retina, yet our perception is so modified as to impart to us but one; although sometimes, in cases of disease, two distinct objects are visible. The picture on the retina must be inconceivably minute, as we can embrace, at one view, a whole district of country, and can watch an object in motion—a horseman, for instance—travel over many miles without our ever changing the axis of vision.

The form of the cornea influences the focus of vision. A flat cornea or small convexity impedes distinct vision of near objects. This diminished convexity is a usual accompaniment of old age. A too convex cornea, on the other hand, prevents distinct vision at a distance, giving rise to near-sightedness. Hence, in the use of spectacles, a convex lens corrects the flat cornea, while a concave aids the cornea, which is too much rounded.

It is supposed that the cornea, or some other portion of the eyeball, is capable of changing its form somewhat to adapt its focus to near or to distant objects. The marsupium of some birds appears conducive to this adaptation.

The aqueous fluid of the cornea, the crystalline of the lens, and the vitreous of the posterior chamber, are each of different densities; and thus the eye becomes what opticians call achromatic—the coloured rays of refracted light are remodified into one colourless mass before they fall upon the retina.

There is a close resemblance between the structure of the eye and the most perfect telescope. Yet the latter was not formed after the model of the former. The telescope was purely an artificial invention; and the perfecting of its parts, especially the introduction of plates of glass having different densities into the lenses, by which they became achromatic, was the result of experiment and deduction. How singularly does this prove the unity of design and purpose which pervades all nature! Man, endowed with reasoning powers, comes to the same conclusions which the Great Reasoning Mind had conceived in the beginning of time! The creature of the dust shews intimations of his original formation in the image of his Maker!

83. Sight, in all that relates to the actual size of bodies, is the most deceitful of the senses. Objects decrease rapidly as they recede from the eye. At the distance of one hundred yards, a horse appears actually no bigger than a rat! A blind boy, who was restored to sight by Cheselden the oculist, on first looking out on the streets, shouted to his friends to come and see four rats running off with a box. This was a coach and four, the real dimensions of which were entirely unknown to him from previous experience. The sense of touch and the knowledge of distance alone correct our sense of vision. In man this knowledge is acquired. In animals it is instinctive and perfect at birth.

84. Vision is denied to many of the lower animals — to zoophytes and a great proportion of the mollusca. Insects are amply supplied with numerous visual discs. The vertebrata are almost all endowed with vision. There are some singular exceptions, however, as the blind rat, (*marmota typlus.*) The proteus, a reptile living in the subterranean lakes of Illyria, is destitute of eyes; and yet Nature, to preserve her chain of analogies, has given the form of eye-balls in its head.

In predaceous animals, vision is generally acute, especially among birds, as the eagle and falcon, which single out and dart on their victims from a great height in the air. Vultures perceive their prey at the distance of many miles, before its odour could reach their nostrils; and thus they fly at once and in a direct line to their feasts of dead and putrifying carcasses. The linear pupil of some animals, as the cat tribe, allows of a greater expansion of the iris, and thus they distinguish objects with very little light.

The loss of sight is the greatest deprivation which can befal an active and intelligent mind. Milton makes Samson feelingly exclaim,—

> Oh why was sight
> To such a tender ball as th' eye confined,
> So obvious and so easy to be quench'd,
> And not, as feeling, through all parts diffused,
> That she might look at will through every pore!

85. SLEEP is a temporary repose, and, in a great degree, a suspension of the nervous functions. Thus the senses are lulled to rest, as well as the muscles dependent upon the will, and all the functions which have been termed relative. The nutritive functions continue, but under a diminished influence. The breathing and circulation are both slower, and thus the animal heat becomes diminished; digestion and assimilation, though they still go on, are not so vigorous as in the waking state.

It is probable, that all animals, even the lowest, experience, more or less, this suspension of their powers; while, in the higher classes, where the nervous system is more perfect, sleep, at stated and regular intervals, is as indispensable as food or air. After repose, the tired-out muscles and exhausted mind feel again invigorated and refreshed; and hence the poet has not inaptly termed sleep the "chief nourisher in life's feast."

86. All the ordinary stimulants of life, pushed to excess, have a tendency to induce sleep; as excess of heat or cold, too much food or fermented liquors, exercise in the open air. The absence of one or more of the usual stimuli also, by inducing debility, has the same effect. Excessive indulgence of sleep induces torpor, obesity, and inactivity of mind and body.

Young animals require more sleep than old, and certain temperaments or constitutions can do with much less sleep than others.

87. The torpidity of certain animals during winter seems to be induced by a diminished temperature acting on a peculiarly constituted system. Such animals are said to hybernate, as the bat, hedge-hog, badger, &c.

88. DREAMING arises from the mind thinking without the aid of the senses. Hence the incongruity of dreams, and the inconsistency of every thing in them that regards time, place, and circumstance. Dreams seem often to be repetitions of the same trains of thought which had occupied the waking hours of the day, only much confused and distorted; or they may arise from faint impressions conveyed through the medium of the lulled senses awakening a confused recollection of past occurrences.

Thus a bottle of hot water applied to the feet suggests ideas of a volcanic mountain, while cold applications give rise to visions of Alpine snows or chill waters. The sound of a falling body will seem the roar of a cannon, and may give rise to dreams of battles, or of attacks of highwaymen. Excessive thirst and dryness of the throat suggest gushing streams or cool delicious fruits. Of all the senses, that of smell seems less frequently an originator of our dreams, and consequently is seldomer mixed up with them.

Dogs, parrots, and other animals, are said to dream, as they not unfrequently scream and use convulsive motions during their sleep. We must be very cautious, however, in determining whether all these arise from mental impressions, or whether they are not simply convulsive movements of the muscles of the throat and extremities, such as frequently take place in human beings, without any accompanying dreams.

If we suppose that animals dream, we grant them the power of forming abstract ideas independent of external impressions, and thus assimilate them with intellectual man. (92.)

SECTION X.

TEMPERAMENT.

89. A certain constitution of the individual, whereby his bodily structure and functions, as well as his mental dispositions, are influenced, has been termed the temperament. Certain relative proportions between the digestive, absorbent, respiratory, and nervous organs, would appear to give rise to temperament.

Thus, when the digestive, assimilative, and bilious functions predominate, a certain habit, called the bilious temperament, is present; when the respiratory and sanguiferous, the sanguine; when the brain and nerves, the nervous.

90. Several combinations and modifications have given rise to corresponding denominations.

The characteristics of these temperaments are shortly these:

SANGUINEOUS.	Fair, florid complexion; figure tall, plump; auburn or light hair; blue eyes, transparent skin; quick perception of intellect; memory tenacious; lively imagination, disposed to hope; versatile, active, impassioned; generally healthy, but tendency to inflammatory complaints. If the mental powers are inferior, an athletic and muscular body.

Bilious	Complexion dark, hair black, features well formed and expressive; muscular system firm and powerful; intellect bold and adventurous, firm, courageous, passionate; liable to affections of the digestive organs and liver; melancholy.
Nervous.	Countenance pale; head proportionably large; muscular system soft, flabby, sensitive; mind highly intellectual, but variable, irresolute, irritable.

A due balance between all these produces the most perfect animal manifestations. That temperament prevails among the human species, giving rise to individual character, national peculiarities and varieties of the race, is abundantly evident, as well as that indications of the same thing are visible among many classes of the inferior animals. We often find individual animals characterized by peculiarities of body, and also temper, which does not universally belong to the species of which he is a member.

The temper or disposition of horses, dogs, sheep, hares, and many others, vary in individuals, nearly as much as in man.

The physiognomy often indicates the temperament in man and animals. Besides the muscles of the face, which have a tendency to assume the form and position which they are oftenest thrown into by the prevailing passions of the mind, there is a lustre of the eye, a tint of the skin, and a varying hue of the features, which all indicate the operations of the passions within.

Instances of this kind are observable every day in the first interview of strange dogs or other animals.

Every person, too, forms an opinion of another at first sight, and these natural impressions are for the most part correct, and at all events influential.

SECTION XI.

INSTINCT.

91. Besides the nutritive functions, which are unceasingly and unconsciously at work in the animal machine, and by which the individual is preserved, and the species multiplied, there are others called instinctive, which guide the animal to its food, its preservation from the weather, and from external injuries, and enable it to provide for the comfort of its tender offspring.

The ordinary degree of this instinct seems to be very analogous to the nutritive functions, which we have alluded to, and would seem to be an extension of the same vital laws which pervade the animal economy. The untaught impulse which directs the young calf to its mother's teat, the newly hatched chick to pick up seeds, or peck at a passing fly, or which makes the bee of a day old perfect in building its cell, or in gathering honey, and flying in a direct line to and from the hive, appears to differ in degree only from the digestive, the circulating, or the secreting operations, which are at the same time set in action within the animal.

These simple instincts are common to all animals, even the lowest; but as we advance in the scale of being, and as the nervous system becomes more complete, the instinctive manifestations also become more perfect, till at last they merge into something like deliberate and rational acts.

92. It is extremely difficult, then, to define the exact nature of instinct, or to draw a line of demarkation between it and reason. By instinct is understood that governing impulse in animals, by which they perform all those operations necessary for their limited sphere of existence, in the fittest and most direct manner, without instruction, experience, or forethought, and which is perfect from the first, and cannot, beyond a very limited degree, be extended in the individual, while it admits of no progression in the species.

Animals have been considered by some as mere machines, performing actions, like automatons, either under the immediate direction of a superior intelligence, or so contrived at the beginning as to perform a certain invariable round of unconscious operations. Others have supposed them really conscious beings, and have endeavoured to separate their actions into instinctive, and deliberative or rational.

Thus, an ant instinctively hoards up grain, but when she bites off the germ to prevent its growth, it is said to be a rational act. A crow instinctively picks the animal out of a sea shell, when it happens to be so protruded as to allow of its being seized hold of; but when the crow takes the same shell, when shut, high up into the air, and lets it drop on a rock, in order to break the covering of its hidden prey, the action is said to be deliberative. A young greyhound instinctively follows the doubling of the hare, but, when old and experienced, he cunningly crosses by a short cut, in order to intercept his prey. Now, in all these, and a number of similar instances, may not the acts called rational be just as much instinctive as the others? Animals are evidently endowed with a variety of instinctive resources, suited to the varying circumstances under which they may be placed; and it is just when these circumstances occur that the suitable instincts are called into action. If many of the so-called rational acts of animals be really the result of deliberation and forethought, they are singularly wise and prudential, and would indicate a high degree of intellectual acumen. But these acts are confined to a few particulars connected with a narrow range of the animal's wants, and the preservation of its young; in all other respects it is stupid and improvident. This differs entirely from the reason of man—it is comprehensive, is derived from the collected experience of innumerable facts, and if acute in one department, is not deficient on the whole.

Animals seem impressed by matter alone. Their instinctive impulses are awakened and stimulated through the direct medium of the senses, either by external causes, or by some unknown changes which take place within their own bodies. They appear to be incapable of forming abstract ideas, or of having their volition stimulated without the impress of matter on their senses.* (See 88.)

The instincts of animals seem very much guided by the high degree of perfection of one or more of their senses. Thus the antennæ of insects possessing touch, and perhaps other modifi-

* Accurate and authentic observations on the manifestations of the instincts of animals are very much wanted. In general, observers are too apt to mix up with their investigations and descriptions human prejudices, and thus to impart rational motives to actions in which perhaps reason had no share. Thus we have *well authenticated* stories of dogs, horses, and parrots, which would shew all these animals to be possessed, not only of a good share of wisdom, humanity, and discretion, but also of fine taste, wit, and repartee. *Ab uno disce omnes.* Prince Maurice saw in Brazil a wonderful parrot, with which he held the following conversation, *through an interpreter*, for he could not speak Brazilian:—"From whence do you come?" "From Marinnan."—"Who do you belong to?" "To a Portuguese."—"What do you do there?" "I look after the chickens."—The prince laughed, and said,—"You look after the chickens?" "Yes; and I know very well how to do it,"—making a chuckle four or five times, as people do who call poultry to them.—*Sir W. Temple, quoted by Locke.*

When Colonel Kelly and his parrot were at Brighton, the bird was asked to sing: he answered, "I can't." Another time he left off in the middle of a tune, and said, "I have forgot." The parrot took up the bottom of a lady's petticoat, and said, "What a pretty foot!" The company teased and moped him a good deal: he said, "I don't like it."—*Jesse, from a memorandum found amongst the late Earl of Guildford's papers.*

cations of sense, in an exquisite degree, are the organs by which their instincts are chiefly influenced. Dogs derive impressions from their acute sense of smell, more than from their other senses; and vultures, eagles, and birds generally, have exceedingly acute vision.

93. Not only are animals guided and influenced by impressions on their senses, which in many are of the most exquisite kind, but they are also possessed of feelings and emotions, and sympathies akin to those of human beings.

That animals are susceptible of emotions and passions is abundantly evident. We find strong attachments subsist between individual animals, and between some animals and man. They experience not only pleasure and pain, but joy and grief, fear and hope or expectation, surprise, wonder, anger, jealousy, pity or commiseration, a love of approbation, and shame, if not regret. Thus, horses that have been accustomed to feed in company, lose their appetite, and fall off in flesh, when confined in a solitary stable. The separation of two fondly attached animals has even caused death. The devotion of a dog to his master is daily to be witnessed. A pointer, on leaving home with a sportsman, evidently seems to anticipate the pleasure of the coming sport. A strange or unusual object readily excites the wonder of an animal. The minute and ceaseless curiosity of the monkey, and many other tribes, are also very apparent, and irritation and offence readily excite anger. When a sea-gull is shot dead, his fellows linger and wail around him. Most animals are fond of being caressed; and a dog actually shews shame, or a consciousness of having committed a fault, for which he is reproved.

Memory, too, or recollection of past impressions, is also very strong in many animals.

94. Man has also instincts, and emotions, and sympathies, like the lower animals, but to these he has superadded reason in its proper acceptation. Man's actions and impulses, except in early infancy, are guided by judgment and reflection. His operations are the result of experience and education. He alone has true consciousness of his existence, of his relation to a Higher Power, and of his moral responsibility for his actions. His knowledge of physical nature is derived from his senses; but he can also form abstract ideas, and think and reason without the immediate aid of external impressions. In him memory extends not only to the revival of past impressions of sense, but also to the recollection of ideas, and to the accu-

mulated experience of long past ages. Imagination, too, can form out of the impressions of the past, an infinite number of combinations, and create in thought, and embody in words, what never had an actual existence. All other animals are prone and grovelling. They live and die, and leave no memorial of existence. Ere man was created, the world was incomplete:

> There wanted yet the master-work, the end
> Of all yet done, — a creature who, not prone
> And brute, as other creatures, but endued
> With sanctity of reason, might erect
> His stature, and upright, with front serene,
> Govern the rest, self-knowing, and from thence
> Magnanimous, to correspond with heaven.—MILTO

The sensations, emotions, and sympathies, also act as so many stimuli on the animal frame. Fine music, and beautiful sights, are no less exhilarating than food and warmth. The beneficent Creator,

> Not content
> With every food of life to nourish man,
> Hath made all nature beauty to his eye,
> And music to his ear.

We have already alluded to the emotion of attachment in influencing the health and even the existence of animals. Loved companions and cheerful society are the greatest zests of intellectual existence. Anger, revenge, and grief, are more deleterious than poisons. Joy stimulates even sometimes to the extinction of life. The animal machine therefore becomes still more wonderful the more we consider it. Not only is it stimulated by material agencies from without, but within itself emotions and sympathies arise, which react on the system from whence they spring; and, according as they are in moderation or excess, produce pleasure and pain: they fan and invigorate the flame of life, or they extinguish it altogether.

SECTION XII.

CLASSIFICATION OF ANIMALS.

95. CONSIDERING the great diversity of forms which we find existing in animated nature, giving rise not only to marked

divisions of beings, differing widely from each other in appearance and habits, but even to minuter shades, constituting innumerable species, it must be evident that in order to study or describe them, some arrangement or classification is absolutely necessary.

Nature has so far made this classification ; but as in her scale of being she does not altogether proceed in a straight line, blending every order, and class, and family, by a progressive imperceptible gradation, neither are her links or circles of natural groups, of which her chain is made up, always complete, or in exact accordance one with another — it follows, that any arrangement, however philosophical, must be so far imperfect, and partake both of a natural and artificial character.

There are certain leading denominations common to all arrangements.

DIVISIONS .	Mark out the great leading distinctions of the whole animal kingdom.
CLASSES . .	Comprehend groups which have certain characteristics in common.
ORDERS . .	Are groups contained within certain classes.
GENERA . . .	Are families of orders having certain common marks of resemblance.
SUB-GENERA .	Are offsets from families.
SPECIES . .	Are certain members of families having an exact resemblance of all their parts, so that every individual of this denomination is a counterpart of another.
Varieties . . .	Individuals of a species having slight differences of unimportant character.

Every animal has two scientific names, — the generic and specific ; the one pointing out the family to which it belongs, the other the branch or species of which it is an individual member. Besides these, there is a trivial or local name generally superadded. If the animal is well known, and an inhabitant of a wide range of country, several of these names, both scientific and trivial, are bestowed upon it : hence originate synonymes. Thus *felis* is the generic name for lions, tigers, cats ; and *felis leo,* the lion, *felis tigris,* the tiger, point out the species. This genus belongs to the order Carnivora, to the class Mammalia, and to the great division Vertebrata.

SECTION XIII.

I. DIVISION—VERTEBRATA.

96. The animals of this division are characterized by having a frame-work or skeleton of bones, which gives support to the body, and permits of extensive locomotion.

The vertebral column or spine is the most conspicuous part in the skeleton, and is common to all the classes of the division. It is composed of a series of joints or vertebræ, through which passes the spinal cord, in a canal common to the whole.

All the members of this division have a brain and nervous system, the five senses, a heart and blood-vessels with red blood, and either lungs or gills. The body is symmetrical, or composed of two halves, and most of its parts and organs are double. In this division there are four classes:

I. MAMMALIA.
II. BIRDS.
III. REPTILES.
IV. FISHES.

CLASS I.—MAMMALIA.

97. This class is so denominated because the young are produced alive, and suckled for a certain time by milk derived from the mammæ of the mother.

The members of this class, though the least numerous, are the most important, and, in general, the largest in size of all the animal kingdom.

ORDER I. BIMANA, Two-Handed.

98. At the head of this class is man, forming a distinct order and a single species.

The physical structure of man differs from that of all other animals, in being adapted for the erect position. For this purpose, his foot is so formed that he treads directly upon its sole; the pelvis is broad, and furnished with large and powerful muscles, which extend along the thigh; and the head, which is large, from containing an expanded brain, is placed on the vertebral column, so as to be supported in an upright position. The arms possess extensive and free motion, and the hand is so formed and supplied with muscles, that every joint of the fingers and thumb is possessed of motion. This complete muscular power, joined to the fine sensibility of touch imparted by numerous nerves and bloodvessels, renders the hand of man superior to any organ of the inferior animals.

Although in muscular power, and in the acuteness of some of the senses, man is surpassed by several animals, yet, on the whole, he may be said to excel in the completeness of his general organization. He can endure long continued exertion, extremes of climate, a low or elevated situation, and all the circumstances attending a diversity of geographical position, better than any other of the inhabitants of the globe. As possessing reason and the faculty of speech, he is also removed to an immeasurable distance from brutes.

From the structure of his teeth and digestive organs, man seems to be allied to those animals that feed on fruits, nuts, and the roots of vegetables; but the art of cookery enables him to convert almost every substance in the animal and vegetable kingdoms to his nourishment. He has hence been called an omnivorous feeder.

Man differs from other animals in his long and helpless infancy and childhood, which has evidently been intended to promote his moral and intellectual culture, and to imbue his mind with those feelings of maternal and domestic attachment, which tend so much to promote the stability of society.

99. There is such a general and particular resemblance of the anatomical structure in all races of mankind, and such an identity in the performance of their animal functions, as prove that all belong to one species; thus confirming the historical account of a single pair having been the progenitors of the whole human race. Yet there are certain peculiarities among these which have led to the division of man into varieties. This tendency to pass into varieties prevails throughout all organized nature. It is seen in plants, and more especially in those species which undergo changes of soil, climate, and culture. In animals it is also remarkable, in those particularly which have been domesticated by man; as sheep, horses, dogs, pigs, and cattle. So great are the changes brought about in these, in regard to size, colour, and the form of their limbs and bodies, that it is sometimes difficult to believe that all the extremes have sprung from a common stock. The

chief causes of this divergence into varieties appear to be modifications of food and climate, and confining the breeds within certain narrow limits. If these varieties of domestic animals are allowed to return to their natural habits and condition of life, the marked peculiarities disappear, and they assume again their original type. It is probable that the same takes place with regard to man; that he has, for instance, in his constitution the susceptibility of diverging into certain varieties, according as he is placed in circumstances favourable to such a change, and thus that climate, food, degrees of civilization, and strict separation into tribes or colonies, may be the external circumstances which call forth the divergence from the original type.

The chief distinction is the tint of the skin; and climate seems to be so intimately associated with this distinction, that in the torrid zone we have the deep black tint, in the more temperate regions a lighter bronze, and, as we pass onwards to the higher latitudes, a still lighter shade, till we come to the white skin and fair hair of the Dane and Norwegian. Exceptions, however, occur. In some districts of Africa, under the same latitude, the inhabitants of the mountains are fairer than those in the plains, and the Esquimaux and wandering Tartar hordes have a dark skin, though living within the Arctic circle.

A certain degree of civilization, too, seems associated with colour. Thus all savages are dark skinned, and civilized nations of a lighter hue. The females and higher classes of the Turks and Hindoos are fairer skinned than the common people.

100. There are three primary varieties of man, — the Caucasian, or white; the Mongolian, or yellow; the Ethiopian, or black. Some have added two others, — the American, or red man, and the Malay, or olive complexioned.

101. The Caucasian is so called from Mount Caucasus and the surrounding region having been the dwelling-place of the primitive families after the Deluge. This variety is distinguished by a fair skin, an oval face, and a well formed head; the features regular, and the nose and chin forming a nearly perpendicular, or slightly bent line with the forehead.

The Circassians, Georgians, Arminians, Arabians, Jews, Abyssinians, and probably Egyptians, belong to this variety. Another branch includes the Indians, Persians, Pelasgians, Scythians, from whence extended the Greeks, Romans, Germans, Celts, Spaniards, Hungarians, and other nations of Europe. These have been distinguished as the great inventors and cultivators of arts, sciences, and every accomplishment conducive to the civilization of mankind.

102 The Mongolian variety is characterized by high cheek bones, flat face, small eyes, placed obliquely in their sockets, straight black hair, scanty beard, and yellow lemon-coloured skin. The Altai mountains are supposed to have been the original locality of this race; and it includes the Chinese, a very ancient nation, the Japanese, the Coreans, and islanders of the Chinese Sea, and the hordes which extend to the east of Siberia, including Russian Tartary. Though the Chinese had attained a considerable degree of civilization at a very remote period — beyond all historical record — yet they have remained ever since in a stationary state, without attempting any advancement. Their literature is circumscribed, and their scientific acquirements of the lowest character.

The inhabitants of the Arctic regions, the Samoiëdes, the Laplanders, and the Esquimaux, partake, in a considerable degree, the characteristics of the Mongolian races, or they may be a degeneration of the Caucasian.

103. The Ethiopian, or negro variety, is marked by a skin of a deep black, the colouring matter residing in the mucous net-work, as explained, sect. vii. 58. The hair is also quite black, short, woolly, and crisped, or curled. The forehead is generally rather small and retreating, the nose flat, and wide at the base, the lips thick and large, the jaws elongated and projecting. This is the general character; but occasionally varieties are found, with more regular and symmetrical features, with long uncurled hair and lighter complexions. Africa, with its islands, is the country of this race; and savage barbarism has too generally characterized the various hordes which wander over its vast deserts.

104. The numerous islands of the South Pacific Ocean are inhabited by different races, who have probably derived their origin from all the three preceding. There are, in these islands, at least two well marked races. The Malays, with regular features, olive complexion, and dark, straight hair. The Papuas, with negro features, and short curly hair. The Malayan race are well formed, quick, intelligent, and susceptible of improvement, and more nearly resemble the Hindoos than any others.

105. The American variety has regular features, not unfrequently the Roman nose, a retreating forehead, with high occiput, long, straight hair, and skin of a red copper colour. They consist of the aboriginal races of North and South America. They are warlike, erratic, and possessed of many of the virtues, and all the vices, of savages; shew little disposition towards civilization, and are rapidly decreasing in numbers. The Chinooks are a tribe who flatten the foreheads of their infants by artificial means.

The three marked varieties of mankind appear to have originated at a very early period. In a painting found in one of the ancient Egyptian tombs, there is an Egyptian sovereign seated on his throne, giving an audience to ambassadors from foreign nations, and among these are the white, the negro, and the Mongolian features and colours, well defined and represented.

106. As man appears in the two capacities of an animal and intellectual being, and as he is instinctively, as well as artificially, a gregarious animal, his most perfect condition must be that of a state of civilization, where individual energies combine for the general good, and where the moral and intellectual faculties are brought into full activity.

In the repeopling of the earth after the Noachian deluge, the seat of civilization appears to have been Babylonia and Chaldea; then it passed into Egypt; and from this cradle of the arts and sciences was knowledge disseminated to Greece and Rome, and from thence westward throughout Europe. The fugitive wanderers from the first centre of civilization would seem to have carried ignorance and barbarity in their train, till at last they terminated in the extreme islands of the South Pacific—the Malayan, New Zealand, and New Holland territories. The stream of intelligence has again changed its course, and now the full current bears onward from the shores of Europe, diffusing itself over the habitable globe.

ORDER II. QUADRUMANA, Four-Handed.

107. The animals of this order are so called because their upper and lower extremities are both furnished with hands. In structure, they very closely resemble man, only they are not adapted like him for the erect position; the hand-like

form of the lower extremities incapacitating them from walking erect, except with great inconvenience, while the slender muscles of the thigh do not afford that firm support to the body which the erect position requires. The teeth are formed like the human; the head and face are also similar, although there is a prolongation and projection of the jaws, which assimilates them to brutes. The brain has three lobes; but the convolutions or furrows on its surface are less numerous than those of man.

These animals live in trees, their four hands, which have four fingers and a thumb, enabling them to climb from branch to branch with facility. Many of them also are furnished with tails, which are prehensile, the extremity of the tail winding round branches of trees, and thus giving additional facilities of movement. Their food consists of fruits, nuts, and roots of plants. All the species are natives of tropical climates. There are three divisions:

108. *The Simia*, or monkeys, with four incisor teeth, and molars, with blunt tubercles; the nails of the fingers flat.

The Ouistitis, with oblique and pointed incisors; nails pointed and claw-like; no cheek pouches.

The Lemurs, with sharp tuberculated teeth and incisors; the nail of the first hind finger pointed, the others flat; fur woolly.

The Simia satyrus (*ourang-outang*) is the most remarkable of this order. Its countenance and form, especially when young, bear a close resemblance to the human. The body is covered with a reddish hair, and the face is of a bluish tint. It is a native of China, Borneo, and Malabar. Its gestures are somewhat similar to those of man, and it imitates many of his actions, is mild and gentle, but does not shew a sagacity superior to that of the dog. It has a loud scream when irritated, but has no powers of articulation.

The Troglodytes, or Chimpensè, is another species, in many respects similar, but covered with black hair. It is an inhabitant of Guinea and Congo, lives in troops, and constructs a hut of leaves and sticks, and arms itself with clubs and stones when attacked by enemies. Some travellers estimate its height as exceeding that of man; but the individuals hitherto brought to Europe are of stature inferior.

ORDER III. CARNARIA.

109. This order includes various classes of animals, formed with sharp teeth and claws, and who live either wholly or partially on animal food. Their teeth are of three kinds, but all more or less pointed, and the jaw has only one motion upwards and downwards. The stomach is simple, and the intestines of moderate length. This order contains several sub-divisions.

110. CHEIROPTERA, or Bat family, is distinguished by a membrane stretched over their four feet, which enables them to fly in the air. In other respects, they are quadrupeds, and resemble somewhat the mouse. The arms and fingers are much elongated, and on the thumb is a hook by which they suspend themselves. Some species have short tails, and some long ears. They live on flies, and are nocturnal, or pursue their prey in the evening and during the night. In winter they become torpid, and suspend themselves in caverns and dark obscure places. They produce two young, and suckle them There are numerous species. The vampire bat is of large size, and pierces the skin, and feeds on the blood of animals.

The Lemurs are still larger, live in trees, and feed on insects and birds.

111. INSECTIVORA. This family is so called from feeding on insects and worms. Many species lead a subterranean life. The hedge hog, the tenric, the shrew, the musk-rat, the mole, the scalops, belong to this division.

The hedge-hog is covered with sharp spines instead of hairs; and the skin of the back being ample, certain muscles enable the animal to draw it over its head and feet, so as to coil the body into the form of a round ball, with the prickles opposed on all sides to an attacking enemy. This animal lives on insects, and occasionally fruit, and lies dormant in its burrow during winter.

The mole lives entirely under ground, and pursues its prey by running along ruts which it constructs in the soil. For this purpose, it is furnished with a projecting muscular muzzle, and fore-legs formed like a hand, with powerful muscles attached. With these it hollows out the soil, and at convenient distances throws up the loose earth to the surface, forming mole-hills. One large hill contains the nest and young of the animal, while from this centre proceed numerous ruts in all directions. The mole has acute sense of hearing. Its eyes are very small, and deeply sunk in its head. It is a gluttonous animal, and cannot endure a long fast. The slightest blow, especially on the head, kills it.

112. CARNIVORA. The true flesh-feeding animals have large sharp pointed teeth, and their muscular bodies and sanguinary propensities constitute them formidable animals of prey. Almost all this family live exclusively on flesh : a few of the weaker sorts, however, as some bears, live partly, if not entirely, on roots and vegetables.

The Plantigrade, or those which place the whole sole of the foot on the ground in walking, constitute a subdivision, including,—

Ursus—the bear.
Procyon—the racoon.
Nasua—the coatis.
Meles—the badger.
Gulo—the glutton.
Ratelus—the ratel.

Of the bear, there are several species, as the brown, the black, the labiated. They are large thick-limbed animals, with a covering of grizzly hair. The black or American bear hybernates, either excavating a hole in the earth, or lying under the deep winter snows. At the commencement of their winter sleep, they are plump and fat ; but this superfluous fat is gradually absorbed to supply them with nourishment. Towards spring, they produce their young ; and at the period of the melting of the snows, they crawl up from their lair exhausted and feeble skeletons. The badger is also a hybernating animal.

113. *Digitigrade.* These animals walk on the ends or tips of their toes. To this division belong,—

Putorius—the polecats.
Mustela—the weasels, martins, sable.
Mephitis—the skunk.
Lutra—the otter.
Canis—the dog, wolf, fox.
Viverra—the civet.
Genetta—genet.
Hyena—the hyena.
Felis—cat, li n, tiger.

The sable, a Siberian animal, is highly valued for its fur. The skunk, when hotly pursued, emits a most insufferable odour. The otter is an aquatic animal, and has webbed feet, and a tail flattened horizontally. The dog tribe have the mouth and nose prolonged, and the sense of smell highly acute. They are also formed for swift running, and hunt down their prey by speed of foot. They frequently also hunt in company.

114. The dog (*canis familiaris*) is the most interesting and the most sagacious of all the brute creation. Since the earliest ages, he has been found the close and attached companion of man; and such is his preference for human society, that he will readily forsake that of his fellows to watch over and accompany his master. His strength, his swiftness, and his acute sense of smell, have rendered him a powerful ally to man in his mastery over the other animals. The dog can scarcely be said to exist as a wild animal; for those which are found in some countries at full liberty are most probably the offspring of individuals once domesticated. As the dog is one of those animals extremely prone to pass into varieties, it is very difficult to say what has been the original of the numerous breeds now existing. Some have supposed the shepherd's dog and wolf dog the original type; or the Esquimaux or New Holland dogs, which have straight and erect ears. The natural food of the dog can be changed by domestication to vegetable matter. The period of gestation is sixty days; the young are born with their eyelids closed, which open about the twelfth day. They acquire their full growth in two years; and the extreme age is twenty years, the average twelve to fifteen. The varieties are numerous, and by training and breeding may be kept distinct; but otherwise they all ultimately lapse into a common type, a sure indication that all are of one species.

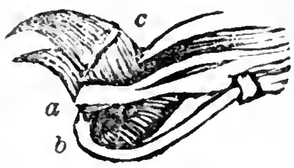
The wolf so nearly resembles the larger dogs, that some have supposed both animals to belong to one species. The wolf was at a remote period an inhabitant of the whole north of Europe. It was extirpated from North Britain about the year 1577.

The hyena is an extremely fierce animal, is gregarious, and lives in caves. It preys on dead bodies, and even robs the human graves of their contents.

115. The feline tribe are distinguished by their short round muzzle, their retractile claws, and their powerful muscular apparatus in the fore-quarters, by which they are enabled to take sudden and forcible leaps upon their prey. In the greater number the pupil of the eye, instead of being round, is of a linear form. The fore-paws are the organs by which they beat down and seize their prey. These are padded

below the toes by an elastic cartilaginous substance, to prevent injury from their sudden and violent leaps upon the ground. The retractile claw is also a curious contrivance to withdraw the sharp point of the nail while the animal is walking, and thus to preserve it unworn and pointed when it has occasion to dart it out in seizing its victim. For this purpose the claw is placed on the upper portion of the last bone or phalanx of the toe; an elastic tendon *a*, keeps the claw, under ordinary circumstances, bent up; the tendon *b* pulls it downwards, while *c*, the retractile tendon, draws it up again. The feline tribe do not run down their prey by speed, but lie in wait for and spring on it. Their habits are wary, cunning, and relentless. They hunt by night, and are solitary and unsocial. The greater proportion are inhabitants of tropical climates: the lynx and common cat, however, range over the greater part of the globe. Our domestic cats are probably derived both from the wild cats of the country and from foreign species imported. The wild cat is characterized by an obtusely pointed tail; but it is said the domestic cat assumes this form also when set at liberty into its native haunts. The feline family may be thus characterized:

No. 17.



A. of a uniform colour, without spots.
- *Felis Leo*—the lion.
- *F. Concolor*—the puma.

B. with transverse vertical spots.
- *F. Tigris*—the tiger.

C. with large circular spots.
- *F. Onça*—the jaguar.
- *F. Pardus*—the panther.
- *F. Leopardus*—the leopard.
- *F. Jubata*—the guepard.
- *F. Uncia*—the once.

D. with oblong spots and streaks; tail long.
- *F. Pardalis*—the ocelot.

E. with streaks and variegated spots.
- *F. Serval*—the serval.
- *F. Chati*—the chati.
- *F. Tigrina*—the margay.
- *F. Catus*—the wild cat.

F. with tufted ears and short tail.
- *F. Caracal*—the caracal.
- *F. Lynx*—the lynx.

116. Amphibia. The animals of this family are so called because they are aquatic. Their feet are short, and the toes are united by membranes, which form paddles, by which they swim with facility. The cellular membrane contains a large quantity of fat, and their hairy covering is thick and short. Of the phoca, or seal, there are several species. It is common in the Northern Seas, and is prized by the Esquimaux as an

article of food. In our rivers, they are very destructive to salmon.

The trichecus, morse, or sea-cow, is characterized by two long tusks projecting from its upper jaw.

ORDER IV. MARSUPIALIA.

117. Marsupialia, or pouched animals, are so called, because the loose skin of the abdomen forms a pouch which contains their young. For the support of this pouch, there are two bones projecting from the pelvis, which are peculiar to all this order, and are found to exist in the males as well as the females. The young are produced in an incomplete state, and of small size, and are afterwards fully developed within the pouch in which the nipples are situated. There are two sub-divisions of this order ; one with sharp pointed teeth and digestive organs, and habits like the insectivora — the other with teeth and stomachs adapted for an exclusively herbivorous food. Both are peculiar to America and New Holland.

The Opossums (*didelphis*) are furnished with fifty teeth, a greater number than that possessed by any other quadruped. Incisors, $\frac{10}{8}$; canine, $\frac{2}{2}$; molars, $\frac{14}{14}$. They have fingers and an opposable thumb, but no nails. The tail is prehensile. They live in trees, are nocturnal, and prey upon birds and insects, and occasionally eat fruit. The Virginian opossum is about the size of a cat, produces sixteen young at a birth, each of which weighs only a grain. After birth, they are put into the pouch, instinctively find the mammæ, and in fifty days acquire the size of a mouse. They now occasionally quit the pouch, but continue to return to it till they become as large as a rat. In some species the pouch is awanting.

The phalangista, or phalagers, belong to the second sub-division, and are characterized by their long pointed incisors, the very small canini of the lower jaw, and the hind toes united nearly to the points by a membrane. The flying phalagers have the skin extended from their flanks to the legs, which enables them to bound through the air for a momentary space. All these live on fruits.

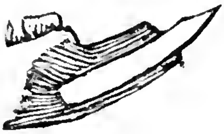
The kanguroos have no canine teeth. The hind legs are unusually large in proportion to the rest of the body, and their mode of progression is by leaps or bounds. They are gentle animals, entirely graminivorous. The gigantic kanguroo is six feet in height. The flesh is esteemed as having the flavour of venison. The young, at birth, are about the size of a mouse, but they increase rapidly in the maternal pouch, and remain there even after they can graze, which they do by pushing out their heads while the mother is feeding.

The phascolomys, or pouched rat or wombat, is in structure similar to the next order, the rodentia. It is about the size of a badger, and burrows like that animal.

ORDER V. RODENTIA.

118. The rodentia, or gnawers, are distinguished by the chisel shape of their incisors, which the animals use in gnawing or filing down their food. They are destitute of canine teeth, and have molars with flat crowns.

No. 18.



The two incisors are covered with enamel on the outer side, but have none on the inner; the consequence of which is, that the inner half is constantly worn down by attrition, leaving the outer edge sharp as a chisel. As the tooth is subjected to constant wear, it as constantly grows up from a curved socket, till at last it is exhausted at the close of the animal's natural period of life. The lower jaw admits of only one motion, in a direction from behind forwards. In general the hind part of the bodies of animals of this order is larger and higher than the fore, so that they leap instead of walk. Those species possessing strong clavicles, as the squirrel, mouse, rat, use the fore legs as hands. The eyes are placed laterally in the head, so that they see both before and behind, as well as on each side. They are mostly frugivorous or graminivorous. Some, however, feed on flesh. Those genera with perfect clavicles are,

Sciurus — squirrel, flying squirrel.
Acotomys — marmot.
Myoxus — dormouse.
Echimys — spring rat.
Mus — rat — mouse.
Cricetus — hamster.
Arvicula — field rat.
Fiber — musk rat.
Georychus — lemming.
Dipus — jerboa.
Helamys — jumping hare.
Spelax — rat mole.
Geomys—Canada hamster.
Castor — beaver.

Those with imperfect clavicles are,

Hystrix — the porcupine.
Lepus — the hare.
Lagomys — rat hares.
Cavia — the guinea pig.
Chloromys — the agouti.
Cœlogenys — the pacas.

119. The harvest mouse is the smallest quadruped, its body being about an inch in length.

The beaver is an aquatic animal. Its hind toes are webbed, and its tail is horizontally flattened and covered with scales. The industry of these animals in constructing dams across rivers is well known. The object of this labour is to form a sufficient depth of water, in order that they may construct their houses, so as they may enter them by diving under the water, and then ascend to the dry station in the upper part. Where the rivers are of sufficient depth, they do not form dams, but construct their houses on the banks.

No. 19.

On the American rivers, the beavers ascend the stream from their lodges in search of food. They make their excursions under water, and have, at certain distances, excavations in the bank, called *washes*, where they retire to breathe without being seen. The hunters discover these places by the hollow sound emitted when trod upon, and here they resort to take the animals. The skin of the beaver is highly valued, and forms an article of extensive trade with the Indian hunters.

The rat hare of Siberia collects heaps of grass, and builds it up like a hay rick, as a provision for the long winter. These ricks are eagerly sought after by the Cossacks, as fodder for their horses.

The musk rat secretes the highly odorous substance, from whence it obtains its name, in certain glands beneath the tail.

The instincts and habits of the hare are very interesting, especially the provisions and resources which nature has bestowed on this extremely timid and defenceless creature,—such as its congenial hue with the furze and stubble where it couches, its projecting eyes, capable of taking a view of every surrounding object, and ever on the watch, even in sleep; its extreme fleetness, its wiles when hotly pursued, and its choice of situations according to the state of the weather.

The rat mole is a singular creature, with an angular head, short legs, and no tail. Its deprivation of vision, too, is also remarkable; the eyeball is awanting, the rudiments of one, or a small point only, being visible beneath the skin.

ORDER VI. EDENTATA. Toothless.

120. All the animals of this order are deficient in the front teeth, while some are entirely toothless. They have also large hoof-like nails, and a slow and difficult progression in consequence of the peculiar organization of their limbs and claws. There are three sub-divisions. 1. The *tardigrada*, including the genus bradypus, or sloth, remarkable for its uncouth figure and sluggish motions. 2. The *dasypus*, including the armadillos, which have a hard, scaley covering over their bodies and tail, and live in burrows under ground; the orycteropus, or ground hog, and the ant-eaters, which are toothless, and furnished with a long tongue. 3. The *monotremata*, containing the echidna and ornithorynchus of New Holland.

No. 20.

These singular animals have the bill of a duck, and their five toes united by a membrane. There is in their skeleton a breast bone, common to the two clavicles, resembling the fourchette or merry thought in birds. In the hind feet of the male is a spur, with a cavity perforating it, through which flows a fluid said to be poisonous. They are aquatic quadrupeds, and covered with fur. It is yet unascertained whether they be viviparous, or oviparous like birds.

ORDER VII. PACHYDERMATA. Thick-skinned.

121. A thick, tough skin, and limbs either hoofed, or with close toes, approaching to hoofs, characterize this order, of which there are three sub-divisions.

122. *Proboscidiana*, with a flexible trunk or proboscis, five toes to each foot, almost covered with callous skin—no canine teeth, but two large tusks depending from the upper jaw. The elephant is the only member of this family; no less remarkable for its gigantic size, than for its strength, agility, and docile manners. The molar teeth are of enormous size, and flat. When old and worn down, they are displaced by a succession of new ones; but as the jaw could not contain both sets of teeth, one below the other, as in other mammalia, the new ones are formed behind the jaw, and advancing forwards, gradually push the old ones out. Two or three supplies of

molars are thus found curiously packed up in the posterior and upper part of the jaw. The elephant lives on grass and leaves of trees. It is said to live for one hundred years. The proboscis is curiously supplied with a multiplicity of muscles ; and while it can tear up the largest tree of the forest, it can also pick up the minutest object on the ground. The young suck with the mouth, not with the proboscis. There are two species now existing, although several more fossil species must have lived at one time on the earth. The Asiatic elephant has an oblong head, crown of the molars with transverse waving lines, exhibiting sections of the worn down laminæ, of which the tooth is composed ; ears comparatively small ; four nails on the hind feet. The African species has a round head, convex forehead, large ears, the crowns of the molars divided into lozenges.

The molars of the extinct mastodon were more pointed or nipple-shaped than the recent elephant, and the sections of the points presented a lozenge shape.

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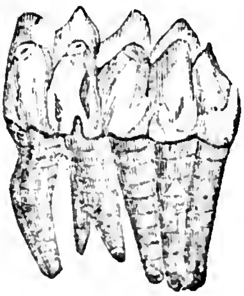
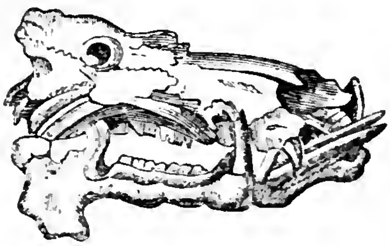


Mastodon tooth.

No. 22.



Head of Hippopotamus.

123. *Pachydermata Ordinaria* have four, three, or two toes, feet somewhat cleft, and digestive organs approaching to the ruminantia.

The hippopotamus has a large naked body, short thick legs, and an enormous head, with a muzzle which overlaps the front teeth. These teeth are very remarkable ; the incisors project in front horizontally, and the canines are large, curved, and smoothed off obliquely at the point, so that they meet and oppose each other like the blades of a pair of scissors. These animals live in the rivers of Africa, and feed on succulent roots and herbs.

The rhinoceros is another unwieldy animal, with three toes on each foot, and a horn on the nose attached to the skin.

The tapir, the hog, the hyrax, belong to this division. Numerous allied fossil animals have also been identified with this family.

124. *Solipedes.* A family with one solid toe or hoof, of which the horse is the type, compose this subdivision.

The horse has six incisors in each jaw, and an empty space between these and the grinders. The male, however, has two small canini in the upper jaw. The incisors are important, as pointing out the age of the horse. The milk teeth begin to grow about fifteen days after birth. At two years and a half, the middle ones are replaced; at three and a half, the two next ones; and at four and a half, the outermost or corner ones. All these teeth have originally an indented crown, which they gradually lose by friction. When seven or eight years old, this is entirely removed, and the horse is no longer marked. The lower canini are produced at three and a half; the upper ones at four. They remain pointed till six, and at ten they begin to peel off.

Th foot of the horse is divided into the hoof or horny part; the coronal bone to which this is attached, the pastern joint immediately above, and the cannon bone, which reaches to the knee.

The horse is the most useful of animals, possessing great beauty and symmetry of form, and a disposition noble, gentle, and affectionate, although impatient and resentful of rude treatment. He is one of the few animals that cannot now be found in his original state of nature, the wild horses of some countries being the domesticated horse turned adrift into the wilderness. Many varieties exist, differing in size, shape, and other qualities. Temperate regions are best fitted for developing his qualities. His natural food is dry grass. When feeding in a wild state, sentinels are appointed to watch, and, by snorting, to give notice of danger.

The horse has a large eye and a linear pupil: his vision at night is very acute. By gentle and kind treatment, he may be trained to various purposes of usefulness, and is docile and affectionate in the highest degree, though his instincts are not very highly developed.

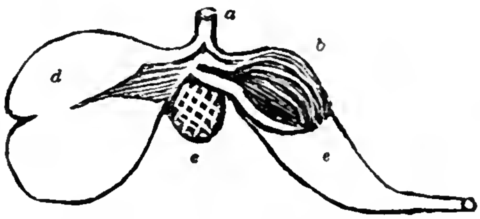
His training is usually associated with his feeding; and in this way his fears and disinclinations are overcome.

The other species of this family are, the dziggtai, the ass, the zebra, and the quagga.

ORDER VIII. RUMINANTIA.

125. The animals of this order, after first swallowing their food, bring it up a second time into the mouth, and re-chew it: hence they are said to ruminate. They have four stomachs.

No. 23.



After half masticating the newly cropped grass, it is passed through the gullet, *a*, into the first stomach or paunch, *d*. From this it passes into the second, *c*, the bonnet, or honey-comb, the sides of which are cellular, like a piece of honey-comb. Here the food is moistened, and compressed into little balls, which are successively taken up into the mouth by a reversed action of the gullet, and re-chewed. After minute mastication, the aliment is again swallowed; but instead of passing into the paunch, it slides through a groove or canal, formed by two membranous sides of the third cavity, *b*, (seen as a dark line in the cut.) This stomach is called the monyplies, or leaflet, from its laminar structure. From the third stomach, *b*, the food next passes into the fourth, *e*, or read. This is the true organ of digestion. The sides are wrinkled, and here the glands lie which secrete the gastric juice.

The foot of the ruminantia is divided into two halves or hoofs. The molar teeth are flat, and the jaw has a rotatory motion. In all the horned ruminantia, the upper incisors are awanting, as well as the canine in both jaws. They are all graminivorous, and their flesh is used as the food of man. They are divided into those with horns, and those without.

126. The camel has canine teeth in both jaws, two upper pointed incisors and six lower, and from eighteen to twenty molars. The toes are united nearly to the point. Attached to the stomach is a cavity, containing numerous cells, which forms a reservoir where the animal can retain water sufficient to supply its wants for several weeks. On its back are two humps, composed of soft muscular flesh and fat, which are supposed to be a provision for its sustenance, by means of absorption, when deprived of food.

The dromedary is another species, with one hump on its back

The camel is only found in a domesticated state, and is a most invaluable beast of burden, adapted by nature for the arid countries in which it exists.

The lama is a South American camel, without humps, and covered with a soft fur or wool much prized in manufactures.

The musk is characterized by two large canine teeth depending from the upper jaw. They are of the size of the goat, and light and elegantly formed.

127. The deer family have antlers, which grow from the heads of the males. They are not horn, but true bone, and are renewed every season, the old ones dropping off.

The, various species are the stag, the moose deer, the rein deer, the fallow deer, Virginia deer, axis, roebuck, &c.

The giraffe, or camelopard, has two small conical horns, which are permanent, and a small tubercle or third horn between. The extreme length of its neck and forelegs renders it a very remarkable animal.

128. The ruminantia with hollow horns have two prominences of bone attached to the skull called moulds, on which the true horns gradually grow, increasing, by successive rings, every year of the animal's life. This horny albuminous matter is identically the same substance as the nails, claws, and hair. In horns, we perceive the fibrous structure of their formation, and the rings or undulations point out the successive annual growth. The horned ruminants have neither canine teeth nor incisors in the lower jaw. The form of the lips and mouth, however, is admirably suited for seizing and cropping the herbage on which they feed. In the fields they browse their food hurriedly, and then retire to thickets and places of shelter to ruminate. They are gregarious, generally swift-footed, and readily perceive the approach of enemies by their acute sense of smell. The genera are,—

Antilopus,—Antilope and gazelle.
Capra,—the goat.
Ovis,—the sheep.

Bos. { Common ox. Auroch. Buffalo or bison. Musk ox. }

ORDER IX. CETACEA.

129. The cetacea, or whale tribe, although aquatic animals, and externally formed like fishes, belong to the mammalia.

They have warm blood, breathe by means of lungs, and suckle their young. They have no hind feet, but the body terminates in a horizontal tail. Their anterior extremities are short, and formed into fins.

The herbivorous cetacea have teeth, with flat crowns, and live on vegetables. They consist of

Manatus — Lamantine or sea cow.
Halicorus — dugong or siren.
Stellerus — stelleri.

130. The ordinary cetacea are furnished with a blow-hole communicating with the mouth and nostrils, and opening at the top of the head, through which they discharge the superfluous water taken into their mouth along with their food; and by means of which they can inhale atmospheric air, simply by raising their head a few inches above water, without the inconvenience of depressing their large bodies, and raising their mouth and nostrils at every inspiration. The body is covered with a smooth skin, without hair, and below is a thick layer of blubber or fat, which serves to give buoyancy to their huge forms, and also to protect them from the cold of an arctic sea. The stomach is divided into five or seven sacks, and they have several small globular spleens. They have two anterior paddles, and a large tail; some species have a dorsal fin composed of tendinous substance; some have round flat teeth, while others are toothless.

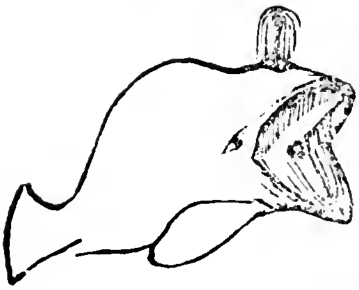
The dolphins (*delphinus*) have teeth in both jaws, and a long muzzle. They are the most carnivorous of the family.

The porpoise, or hog fish, has a short convex muzzle.

The narwhal, or sea unicorn, has a projecting spiral tooth, from seven to ten feet long. A second tooth remains undeveloped in the jaw.

The cachalots have an immensely enlarged head, or rather face and jaws. The upper jaw is toothless, but the under contains a row of conical teeth, which enter into corresponding cavities of the upper jaw.

No. 24.



The *balæna mysticetus*, or common whale, has a large somewhat elongated mouth. The jaws contain no teeth, but are furnished on each side with laminæ of whalebone, which serve to retain the minute medusæ on which the animal feeds. The orifice of the gullet is extremely small compared to the mouth and size of the animal.

The whale exceeds in size any other animal, being, on an average, seventy feet in length. Floating in the dense element of water, this huge mass, weighing upwards of one hundred and sixty thousand pounds, which would be unwieldy on land, is possessed of considerable agility, and has prodigious muscular power, especially in the tail.

The whale is valued for its blubber, from which oil is procured; and for the elastic horny substance of the jaw, called whalebone.

SECTION XIII.

CLASS II.—AVES, BIRDS.

131. Birds form the second class of the vertebrata, and are distinguished from the mammalia by their oviparous birth, the young being hatched from eggs.

They are also, with one or two exceptions, adapted for flight; and, accordingly, we find arrangements in their skeleton and other parts of their bodies, for this purpose.

They are bipeds, and stand in a semi-erect position, their bodies hanging forwards. The upper extremities are formed into wings, and they use their mouth and bill for picking up their food.

132. The neck is long, and contains numerous vertebræ, while the pelvis is very much extended, to admit of the many strong muscles which are attached to the thighs, for the support of the body. The sternum, or breast bone, is also large, and is divided in the middle by a keel, on each side of which is a hollow, where lie the thick and powerful muscles that move the wings. The junction of the two clavicles forms the fourchette, (*merry thought*,) which keeps the shoulders

apart in the rapid motions of the wings. The last bone of the wing corresponding to the hand and toes of the mammalia, has one finger, and the rudiments of two more. These serve to give attachments to the spurious quills of the wing. The tail bone is short, and affords attachment to from twelve to fourteen quill feathers. The ribs are strengthened and supported by transverse portions of bone, which unite about their middle. The leg consists of the femur, or thighbone, and the tibia and fibula: these are connected at the carpus by a spring-joint, which keeps the leg extended without any muscular exertion on the part of the animal. The foot contains one bone, which terminates in three pulleys. The toes are generally three, with an opposing toe behind.

133. There is a beautiful muscular contrivance in the leg, especially of those birds that perch on trees, for keeping the claws fixed to the branch, without an effort of the animal. For this purpose, a set of muscles take their origin in the pelvis, and their tendons passing along the thigh, cross obliquely the knee-joint, bend under the heel, and are inserted into the inferior part of the toes. Thus, the mere weight of the animal's body, when it goes to rest, by bending the joints of the thigh and leg, puts the tendons on the stretch, and forcibly draws the claws around the perch. In this position, the bird sleeps in safety amid the rocking of the boughs in the highest gales.

To increase the weight, and consequently the tension of the tendons, some birds sleep with one foot drawn up, while others grasp a stone in it. The common practice, too, of sleeping with the head under the wing, brings the centre of gravity more within the line of the legs and feet.

134. Birds are covered with down and feathers of an extremely light texture, and of a nature to protect their bodies from the atmospheric changes to which their flights expose them. The feathers are attached to the skin by a hollow quill filled with air, and which at first contained the nutritive vessels from whence the plume was developed. The numerous lateral fibres of the quill-feathers are ingeniously hooked together by their serrated edges—a contrivance which admits of their compactness being easily restored, although ruffled and separated by the rapid motion to which they are continually subjected. The surface of the feathers, especially in aquatic birds, is kept waterproof by an oil secreted in glands near the tail, and which is regularly smeared over them by the bird using its bill for this purpose.

135. The lungs of birds are placed close to their ribs—they are undivided, and are enveloped by a membrane pierced with holes, through which a quantity of the inspired air is forced into various sacs and cavities of the chest and abdomen, and also into the interior hollows of the bones, to add to the buoyancy of the body.

The respiratory and circulating organs are vigorous, and the animal heat is greater than that of the mammalia.

Birds have no teeth—their mandibles are prolongations of the maxillary bones, and are covered to a certain extent with a horny bill, varying in size and hardness.

136. The digestive apparatus consists of three parts, a dilatation of the œsophagus, called the crop; a membranous ventricular sac which pours out a fluid analogous to saliva, by which the food is moistened, and rendered soft and pulpy; and the gizzard, or true stomach, composed of thick and powerful muscles, and lined internally with a cartilaginous villous coat. Here, especially in granivorous birds, are found a number of sharp-edged pebbles, which the animal swallows, and which assist in the trituration of the food, preparatory to its solution in the gastric juice. In carnivorous birds, the stomach is more simple, approaching to the single sac of the flesh-feeding mammalia.

137. The brain of birds is large in proportion to the body, especially the cerebrum, which, however, contains no convolutions.

The sense of sight is very perfect in birds, and is adapted both to near and distant vision, by certain changes of the convexity of the eyeball, and position of the lens. The marsupium, a muscle attached to the posterior chamber of the eye, is supposed to be conducive to this arrangement. Birds have a third eyelid, called the *membrana nictitans*, which, at the same time that it protects the eye in the rapid flights of the animal, permits of a certain degree of vision. The hearing of birds is also acute—although, in general, there is no external ear, but merely an orifice. In nocturnal birds of prey, as the owl, the external ear is of great size.

The orifices of the nose are placed at the base of the bill. The acute sense of smell of the vulture and other birds is disputed; and they probably depend more on their powers of sight in singling out their prey.

The tongue of most birds contains little soft flesh, and is composed chiefly of cartilage and bone. The sense of taste seems not to be very great. Neither can touch be very exquisite, as every part of their body is covered with substances ill adapted for conveying sensitive impressions.

138. The trachæa, or wind-pipe, consists of entire circular rings. At its lower part, where it branches into two, is placed an epiglottis or elastic flap, by which sounds are produced, and where emanate the notes of song birds. The large proportion of air inhaled, and the powerful muscles of the chest, enable those little animals to pour forth an amazing volume of sound, the modulations of which are, in some cases, so exquisite.

139. The shape of birds is admirably suited for quick movements through the resisting air. Thus the body tapers at both ends, and swells out gently in the middle. The feathers of both wings are also equally adjusted, so that their actions exactly coincide; the wing is concave above and convex below, thus presenting a rounded and slightly resisting surface in its elevation, and a strong resisting surface in its depression. By modifying the quantity of air thrown into their bodies, birds can also soar high into the atmosphere, or skim the surface of the earth. The eagle, the falcon, the kite, and many others, after ascending to a great height, become so buoyant from the expansion of the air contained in their cavities, that they soar and float along almost without the efforts of their wings. When they wish to descend rapidly, they suddenly expel the superfluous air, and thus render their bodies heavier.

Most birds renew their feathers twice a-year, which is termed moulting. At these periods, they are sickly. Some assume a different colour of plumage in summer from that of winter, as the ptarmigan; and, in general, the colour of birds varies according to their age.

The ingenuity and perseverance displayed by these animals in constructing their nests, and the all-absorbing interest which the care of their young excites in them, are not the least interesting portion of the history of the feathered tribe. If, to this, we add the beauty and variety of their plumage, their wheeling flights through the air, and their melody associated with every thing that is lovely in nature, and cheering in the season of the year, we need not be surprised that they should so frequently engross the fondest speculations of the lover of nature.

140. Possessed of such powers of locomotion, the migrations

of birds are more frequent and more extensive than that of most other animals. There are two kinds of this migration. The one of birds that spend the summer in our temperate climates, and leave us on the approach of winter—such as the swallows, the cuckoo, quails, &c. ; and the other of those that leave the arctic climates at the close of the year, and come to spend a milder winter on our insular shores. Of this kind are, the swan, goose, dotterel, &c. More partial migrations take place from one part of a country to the other, at particular seasons, and among particular classes of the feathered tribes.

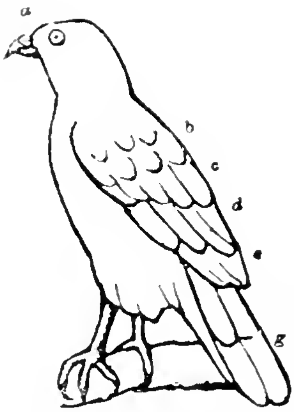
In these migrations, the birds take advantage of land as much as possible, and skim along the coasts, or cross the inland countries, resting when they become exhausted. As birds fly at the rate of from fifty to a hundred miles an hour, the crossing of a sea, or a considerable space of ocean, especially to those that have amazing strength and endurance of flight, is not deemed an arduous undertaking.

After all, such migrations seldom extend across a wide space of ocean. No American birds come to this country, or Europe, except in rare instances, when stragglers are forced out to sea by hurricanes. The male birds are said to take the lead in their migratory flights, and to arrive a day or two before the females. The great sympathy which birds manifest with atmospheric changes—the presence or absence of the food on which they live—and a certain unknown internal change, in some cases exhibiting symptoms of increased heat and irritation in their systems, seem all conducive to excite the particular instinct which impels to emigration.

> There is a Power, whose care
> Teaches thy way along that pathless coast,
> The desert and illimitable air,
> Lone wandering, but not lost.
>
> All day thy wings have fann'd,
> At that far height, the cold dim atmosphere,
> Yet stoop not weary to the welcome land,
> Though the dark night is near.

In describing birds, it is necessary to be acquainted with the following terms :

No. 25.



a the cere, a naked piece of skin at the base of the bill in several species of birds; *b* the wing coverts or tectrices; *c* the tertials of the wing, attached to the second bone; *d* the secondaries; *e* the primaries attached to the first bone or carpus; *f* the rump feathers; *g* the middle tail feathers. The other terms are, the occiput or back of the head—the gorge or throat—the ventre or belly.

The nests of birds are interesting objects, and vary in structure according to the species. The eggs also are of different hues and shapes, according to the families to which they belong. In many instances, the colour of the egg is adapted to the surrounding objects among which the nest of the bird is situated. The development of the chick in the egg has been explained sect. vi. 48.

141. The form of the bill, and feet and claws, afford the distinctive marks of classification. Temminck arranges birds into sixteen orders.

ORDER I. RAPACES, BIRDS OF PREY.

142. These are distinguished by their strong, hard, and hooked beaks and talons, large wings, muscular bodies, and acute vision. They have four toes on the foot, and a membrane or cere at the base of the upper mandible. They prey upon other birds and small animals, and are strictly carnivorous. They are divided into diurnal, or those that prey during the day, and nocturnal or night feeding. The diurnal comprehends the vultures, condor, eagles, and the hawk family. The nocturnal, the owls, of which there are several species.

The golden eagle is, like the lion among quadrupeds, the king of birds, and this distinction he merits from his size, muscular form, noble and daring aspect, and his prowess as a hunter. These birds, like carnivorous quadrupeds, are solitary, comparatively scarce, bring forth only two young, and build their nests in high and inaccessible rocks and mountains.

The owl exhibits a structure admirably suited for its nocturnal habits. Its soft silken plumage enables it to flit through the dusk with a noiseless motion—its eye is, like the cats, adapted for nocturnal vision—and its external ear is most ample, and calculated to take in the slightest sound which the birds or mice, on which it preys, may convey to it.

ORDER II. OMNIVORES.

143. Embraces those birds which live on all kinds of food. The beak is robust, of middle size, and sharp on the edges; the upper mandible convex, and notched at the point; feet with four toes; wings of medium length; quill-feathers terminating in a point. Among this order are ranged,—

Corvus—the raven, hooded-crow, rook, daw.
Sturnus—the starling.
Garrulus—magpie, jay.
Oriolus—the golden oriole.
Paradisea—birds of paradise.

The crow is remarkable, as being one of the few animals which are found in every climate, and almost every region of the globe. It feeds chiefly on worms and insects; and hence is supposed to do less harm to the fields of the farmer, than the benefit that it bestows, by ridding the ground of vermin. A rookery is an interesting scene, where the instinctive sagacities of the crow are amusingly developed.

ORDER III. INSECTIVORES.

144. The bill is short, or of a middle size, straight, rounded, or curved. Upper mandible curved, and notched at the tip; base for the most part beset with bristly hairs; feet with three toes before, and one behind, with parallel articulations, the exterior toe adhering at its base; or, in some species, to the first phalanx of the middle toe. This order includes many song birds. They live chiefly on insects in summer, and on berries and seeds in winter. The principal genera are,—

Turdus—thrush, blackbird, mocking bird, ouzel.
Troglodytes—wren.
Edolius—malabar edolius.
Saxicola—chat, wheat-ear.
Lanius—shrike.
Muscicapa—fly-catcher.
Motacilla—wagtail.
Sylvia—warblers, red-breast.

ORDER IV. GRANIVORES

145. The bill more or less conical; short, strong mandibles,

mostly without notches; wings of medium length; four toes, the anterior ones entirely divided; feed on seeds of plants and grain.

Alauda — lark	*Pyrrhula* — bullfinch
Parus — titmouse	*Fringilla* — finch
Emberiza — bunting	*Colias* — coly
Loxia — crossbill	*Tanager* — black tanager

The bullfinch is celebrated for its musical powers, and the facility with which it may be taught to sing airs. The cross-bill has a singular bill; the points of the mandibles crossing each other, from whence it derives its name.

ORDER V. ZYGODACTYLI.

146. The form of the bill varies, is more or less curved, sometimes hooked or straight, and angular. The feet have two toes before, and two behind. Among the genera are,

Cuculus — cuckoo	*Psittacus* — parrot, cockatoo
Ramphastos — toucan	*Picus* — woodpecker
Trojen — quizel	*Yunx* — wry-neck

ORDER VI. ANISODACTYLI.

147. Bill more or less bent, or straight; slender feet, with three toes before, and one behind, the exterior one always adhering at its base to the middle toe; the hind toe usually long; all the toes with long bent claws. Includes

Oxyrhynchus	*Certhia* — creeper
Scitta — nut-hatch	*Tichodroma* — wall-creeper
Trochilus — humming bird	*Upupa* — hoopoe

The humming birds are the smallest and most brilliant in their plumage of all the feathered tribes. They are natives of America.

ORDER VII. ALCYONES.

148. Bill of medium size, long in some species, pointed, and nearly quadrangular, either straight or bent; tarsus very short; three toes before, adhering, and one behind. Including

Merops — bee-eater	*Alcedo* — king-fisher
Dacelo — gigantic dacelo	

ORDER VIII. CHELIDONES.

149. Bill very short, greatly depressed, and much dilated at the base; the upper mandible curved at the point; legs short; three toes before, and one behind; front toes free, or connected at the base by a short membrane; claws much hooked; wings long. Including

Hirundo — swallow, swift, martin
Caprimulgus — goatsucker
Podargus — horned podargus

ORDER IX. COLUMBÆ.

150. Bill of medium size, compressed; the base of the upper mandible covered by a soft skin, in which the nostrils are situated, the point more or less bent; feet with three completely divided toes before, and one behind. Containing the family of pigeons, remarkable for their symmetry of form, great capability of domestication, and power of sustaining long and rapid flights. Pigeons feed their young by discharging from their crop the softened grain and pulse which they collect there. The rock pigeon is supposed to be the original of our European varieties.

ORDER X. GALLINÆ

151. Bill strong; short, convex, and in some genera it is partly covered by a cere; upper mandible bending from its base, or only towards the tip, and projecting over the point of the lower one; nostrils protected by a cartilaginous scale, naked in some, and feathered in others; wings short and concave; feet with three toes before, and one behind, united at the base by a membrane. Includes

Gallus — domestic cock
Phasanius — pheasant
Meleagrus — turkey
Numida — guinea-fowl
Tetrao — grouse
Perdix — quail, partridge

The domestic fowl, and the pheasant, are supposed to have come originally from Asia. The turkey is a native of America. The ptarmigan, or white grouse, is an Alpine bird, and changes the colour of its plumage on the approach of winter.

ORDER XI. ALECTORIDES.

152. Bill the size of the head, or a little shorter, strong and robust; the upper mandible convex, and frequently hooked at the point; the toes slender, three before and one behind, the articulation of the hind toe higher than those before. The genera are,—

Psophia — trumpeter	*Palemedea* — screamer
Dicholophus — crested dicholophus	*Channa* — jacana
Glariola — collared pratincole	

ORDER XII. CURSORES.

153. This order is characterized by a bill of medium size or short, long legs and naked above the knee, with two or three anterior toes only. It includes some remarkable genera, as

Struthio — ostrich	*Otis* — bustard
Dromaius — emu	*Cursorius* — courier
Casuarius — cassowary	

The ostrich, of which there are two species, the African and American, is the largest and most powerful of birds. The African ostrich is six to eight feet high. It is not adapted for flight, and therefore has the legs more muscular than the wings; and the body is covered with plumes of detached filaments, instead of the compacted feathers of other birds. The third, or inner toe, is so small and imperfect, as to have been overlooked by many observers. It runs with great swiftness, assisted by its wings. When hotly pursued, it is said to dash stones behind it with great violence. It lays its eggs on the sea sand, and leaves them to be hatched by the warmth of the sun. These eggs weigh nearly three pounds each. In colder temperatures, the same bird, however, sits on and hatches its eggs with the utmost assiduity. It feeds on grass and grain; and so powerful is its large gizzard, that it wears down and obliterates the stamp of coins that it may have swallowed. The American species is smaller, and of a grayish yellow colour.

The emu is seven feet high; colour of plumage brown, of different shades, consisting of pendulous plumes of a hairy texture. It is a native of New Holland.

ORDER XIII. GRALLATORES.

154. The birds of this order, from their habits, are called waders. The bill varies — is generally straight, elongated, conical, compressed, and rarely depressed. The legs are long and slender, and for the most part naked above the knee. Three or four toes. The genera are numerous, and are subdivided into groups. Among these are, —

Charadrius — plovers
Grus — cranes
Scolopax — woodcock
Rallus — rails

ORDER XIV. PINNATIPEDES.

155. Bill of medium size; legs of moderate length; the toes with half or rudimentary webs along their sides. The species living much in the water.

Fulica — coot
Podiceps — grebe

ORDER XV. PALMIPEDES.

156. Bills varied in form, some round, others flat, legs short, and placed far behind, anterior toes, wholly or partially connected by a membrane, hence the term web-footed. The species are all aquatic; and the families are numerous.

Larus — gulls
Procellaria — petrels
Diomedea — albatross
Anser — goose
Cygnus — swans
Anas — ducks
Colymbus — divers
Mormon — puffins.

Many birds of this order are migratory; spending their summers, and breeding in the arctic regions, and coming to more temperate climates during winter. They live on fish and marine animals.

ORDER XVI. INERTES.

157. Characterized by short, thick, inactive bodies; legs placed far behind; toes short; wings not fitted for flight. The *apterex* inhabits New Zealand. *Didus*, the dodo, within the last two hundred years, was found in the Mauritius, but is now extinct.

SECTION XIV.

CLASS III.—REPTILIA, REPTILES.

158. In the class of reptiles, we begin to perceive a falling off from that complete organization and vigorous play of the vital functions, which are found in the preceding classes. This is remarkable in the less hard or compact structure of the bones, and the deficiency of portions of the skeleton; in the feeble power of producing animal heat, arising from an imperfect aëration of the blood; in their sluggish motions; diminished power of excitability, and the obtuseness of the organs of sense.

The skin of reptiles is either naked, or covered with scales; and among some tribes it is periodically thrown off and renewed. They are cold, red blooded animals, respire by lungs, and some also by branchiæ. Some are without feet, others have two, and four. Certain species live on land, others are aquatic. The structure of the heart, and the circulation, is peculiar. The whole blood does not regularly pass through the lungs, a part of the venous blood flowing by a direct communication from the great veins to the vessels of the left side of the heart. Respiration is also frequently interrupted for a considerable period without injury to the life of the animal. The heart is either single or double. The lobes of the lungs are unequal, and the cells larger than in the higher classes of animals.

In consequence of this imperfect respiration, the animal heat is kept low, the temperature rising very little above that of the surrounding medium, the whole animal energies also partake of this diminished activity — their motions are slow, their appetites irregular, their absorbent and exhalent systems inactive, and so powerless are they in resisting cold, that in diminished temperatures they fall into a state of torpidity, and may be frozen with a cold which congeals water.

The brain is small, and the manifestations of instinct very incomplete. The living actions are frequently carried on after decapitation; such as pulsation of the heart, and muscular motion, circumstances that indicate the influence of the nerves and ganglions on the vital functions. The senses of reptiles are five, but they are obtuse, and in some cases very imperfect. The hard horny plates, or the tough skins with which they are covered, prevent a delicate sense of touch. The ear is simple in its structure, and not very sensitive to impressions of sound ; and the eyes are frequently covered by a semipellucid membrane.

Reptiles are oviparous, either producing spawn, which becomes vivified without the hatching or care of the parent, or they are ovo-viviparous, producing eggs containing living young. In the frog, and some others, the young undergo successive metamorphoses in their embryo state. (See Sect. vi. 48.)

This class has been divided into four orders.

ORDER I. CHELONIA, TORTOISES.

159. The heart has two auricles, and the body is incased in a horny buckler, or double shell, composed of plates called tortoise shell.

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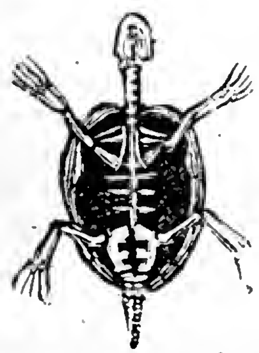

Although the external appearance of these animals would not indicate any resemblance to the vertebrata, yet, on examining them internally, we find a bony skeleton with a vertebral column, though somewhat imperfect, and four extremities exactly similar in structure to those of the higher vertebrata.

Tortoises have no teeth. The cavity of the chest not permitting of alternate elevation and depression, they respire by an effort of the mouth and nostrils alone. Through the latter they inspire air; and placing the tongue over the inner cavity of the nostrils, so as to shut it, they force the air down into the lungs. Some live on vegetable matter, others on insects and fishes, but they can remain months, and even years, without eating. They are said to live, at least, a century. Tortoises are divided into land, fresh water, and marine. The turtle is esteemed for the richness of its flesh. It is from six to seven feet in length, and weighs from seven to eight hundred pounds. It is gregarious, and feeds on sea-weed, and lays its eggs on the shore among sand.

ORDER II. SAURIA.

159. The heart has two auricles. The body is covered with scales, and there are three or four feet. The lungs are

large, and extend along the back. The mouth is armed with teeth, and the toes with claws. The tail is long, and often thick at the base.

Crocodilia—crocodile.	*Geckotida*—geco.
Lacertinidia—lizards.	*Cammæleonida*—chameleon.
Iguanada—iguana, draco.	*Scincoide*—elongated lizard.

The crocodiles, of which there are two kinds, the gavial and alligator, are aquatic animals, thirty feet long. The young are produced from eggs, which, notwithstanding the size of the animal, are not larger than those of a goose.

The chameleon (*little lion*) lives in trees, and feeds on insects. It has several curious adaptations for its mode of life. Its toes are admirably formed for grasping the branches —its tail is prehensile—its eyes project from the sockets, and, incased in a tube, can be moved in all directions without motion of the head. The colour of the skin is susceptible of three or four shades, yellow, green, and purple, suiting it to the tints of the leaves; and the tongue, which equals in length its body, has such elasticity as to be compressed into half an inch, and suddenly extended to six or seven inches. Its tip is hollow, and covered with a viscid fluid, for entangling flies. The lungs are of enormous proportions to its body. The change of hue seems to be influenced greatly by the quantity of light—by the respiration, and the passions, and desires of the animal. Its locomotion is extremely sluggish.

ORDER III. OPHIDIA.

160. Serpents have elongated bodies—without feet—a heart with two auricles—some with one lung—a scaly covering, or naked skin. The skeleton consists of a vertebral column, and ribs—sometimes the rudiments of feet are visible. Among the families are,—

Anguina.	*Coluber.*
Amphisbæna.	*Crotalus.*
Typhlops.	*Vipera.*
Boa.	*Nuda.*

Serpents are either innocuous, or furnished with a poisonous apparatus.

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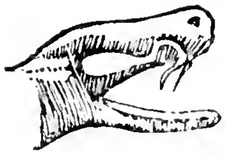

The venomous serpents, as the coluber, rattle-snake, vipers, have a bag in the upper jaw, which contains a poisonous fluid. When a wound is made by a bite of the animal, this fluid passes by a duct along a groove in the tooth, and thus is instilled into its victim. They have a slender forked tongue.

The motion of serpents is of a waving nature, produced by the successive actions of the muscles on their jointed body. Some live in water, others on the ground, and a few in trees. Their eggs are generally connected together.

The boa is above thirty feet in length. Its jaws are of great capacity, and it bruises its prey into an elongated flattened form before swallowing it, smearing it over with saliva. The rattlesnake has a horny jointed appendage to its tail, by which it makes the peculiar noise, from whence its name is derived.

ORDER IV. BATRACHIA.

161. The frog tribe have a single heart, two lungs, and in their embryo state branchiæ, which, in some species, as the siren, are retained through life. They have four or two feet, with webbed toes, and a skin without scales. The genera consists of,—

Rana—frogs.	*Proteus.*
Salamandra.	*Siren.*

The males of the green frog croak very loud, and, in doing so, expand two large bladders placed at the angles of the mouth.

The ova of the pipa or Guinea frog are hatched on the back of the female, where they grow into tadpoles, and remain there for three months, till they have acquired four legs.

The tree frog of America adheres to the leaves and branches of trees, by a slimey matter which covers its skin.

The toad is a loathsome-looking animal, but is not poisonous. It is very retentive of life; and instances are adduced of its living entombed in hollows of stones and trees for centuries.

SECTION XV.

CLASS IV.—PISCES, FISHES.

162. Fishes form the fourth and last class of vertebrated animals. The bones are less compact even than those of reptiles, and have a fibrous structure. The vertebræ are circular, with hollow cavities on both ends, instead of the alternate concave and convex surfaces, by which those of the higher vertebrata are jointed. These circular vertebræ are connected by an elastic cartilaginous substance, which admits of a vibrating motion horizontally. The processes of the vertebræ expand into ribs, having a groove on each side, along which the nerves and ganglions pass.

The head is composed of numerous bones, imperfectly connected together by cartilage and ligaments. The fins are in place of limbs, and are supported by small bones, corresponding to the tarsal bones of the higher animals.

163. The heart of fishes is single, consisting of one auricle, and one ventricle. The blood is propelled from this ventricle to the vessels of the branchiæ or gills, situated on each side of the head. Over these gills, the water taken in by the mouth, in a manner analogous to respiration, constantly passes; and after imparting a quantity of oxygen gas contained in it to the blood, escapes through an opening covered by a flap, called the operculum. The venous blood having thus received a quantity of air, is conveyed into a vessel, corresponding to the aorta, by which it is circulated throughout the body.

The covering of the gills is called the operculum, and is divided into three parts; in some orders of fishes, the operculum is absent, and the external communication is by several circular openings.

The scapular bones, and the pelvis, are very imperfect in fishes, are unattached to the rest of the skeleton, and vary in their positions.

Fishes are cold blooded, their respiratory functions being no more than adequate to keep their temperature a little above that of the surrounding medium.

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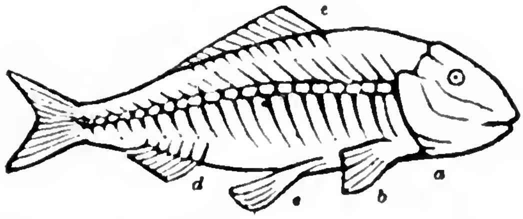


a operculum, or gill cover. *b* pectoral fin. *c* ventral. *d* anal and caudal. *e* dorsal.

164. The shape and entire structure of fishes are adapted for the medium in which they live. The body tapers towards the head and tail, and swells out in the middle. The fins and tail are the organs of motion. These fins are composed of membrane, supported by rays. The spinous rays are composed of a single piece, hard, flexible, pointed; the articulated, or branched rays, are made up of joints or branches articulated together. The number of fins vary in the different classes; there are generally four, sometimes two; and, in some cases, none. They are named from their positions, as explained in the wood cut.

Besides the skin, there is a covering of scales in a great proportion of fishes, and these vary in form, according to the different orders.

Along the body of the fish, on each side, there is a line of peculiar scales, in many cases forming a dark band, as in the haddock. In these there are glands which secrete a tenacious mucus, with which the surface of the body is kept constantly lubricated, and thus the macerating effect of water is prevented. There are cirri, or long tapering bodies, which spring from some fishes, that seem to act as organs of touch.

165. The brain of fishes is small, and does not fill the entire cavity of the cranium. (Sect. viii. 63.) The different parts of the brain are arranged one after the other. At the base of the olfactory nerves, are ganglionic knots. The nostrils open by two simple cavities at the end of the muzzle.

The cornea of the eye is very flat, to adapt it to the dense medium of water; and there is little aqueous humour. The lens is almost spherical, and made up of innumerable compact layers of albumen. The tongue and palates of fishes can have but little sensibility of taste, as they are both composed chiefly of bone.

The teeth are numerous, and situated in all parts of the front of the jaws, mouth, tongue, and branchiæ. They vary much in form; in general, they are used more as a means of entangling their food, than for masticating it, a few orders only having round grinders. The teeth are simply attached to the palate, or external surface of the bones of the jaw, not indented into sockets, as in the other vertebrata.

The stomach of fishes is simple, as well as the intestinal canal, and their digestion rapid. In a great proportion of fishes, there is immediately below, and in the hollow of the spine, an air bag, which communicates either with the gullet, or the branchiæ, or with both. Attached to this, are certain muscles, which, by acting on this bag, compress or permit it to expand at the will of the animal; by this means, the air is so modified, as to render the body lighter or heavier, so as to permit of the animal's easy ascent or descent in the water. To fishes that live in deep seas, where their range may be a mile or two of perpendicular depth, this contrivance is indispensable. Flat fishes that inhabit shallow water, as the ray or flounder, have no such air bag.

As the progressive motions of fishes are all caused by horizontal movements of the body, the muscular fibres range in a direction from the head to the tail, and have thus a greater uniformity of action than in terrestrial animals. In some, the colour of the muscles is reddish, in the greater proportion white. The greatest muscular power resides in the parts connected with the tail.

166. Fishes propagate by spawn. The roe, or egg bag, is contained in the female, the milt in the male. The spawn is deposited in the sand of shallow seas and rivers, and the development of the young is left to the heat of the sun and air. Fishes are amazingly prolific. The spawn of the carp contains two hundred thousand; that of the herring, thirty thousand; the flounder, upwards of a million; the cod, three millions. Many fishes are migratory, and their movements are from deep seas to shallow, and from the arctic regions to the more temperate latitudes. They thus migrate, to procure particular kinds of food, and to deposit their spawn. The generality of fishes, however, like terrestrial animals, are more fixed to certain localities, than might at first be supposed from the fluctuating nature of the element in which they live. It is believed that salmon continue to frequent the same rivers during spawning time for successive generations.

Fishes are supposed to be long lived; and instances are recorded of pike having existed for two hundred and sixty years.

They are not devoid of instincts, although their habits are not easily ascertained. They may be tamed, so as to feed from the hand. And they will come to be fed at stated periods, thus indicating the power of memory.

Fish form a light and nutritious food, and are of great importance in an economical and commercial view.

Isinglass is the glutinous matter of the skin and bone of the sturgeon and other fishes.

167. There are two great divisions of fishes,—those with a bony skeleton, and the chondropterygii, or cartilaginous.

ORDER I. ACANTHOPTERYGII, Spiny Fins.

168. With spines supporting the whole, or the first rays of the dorsal fin, or where the fin is wanting a few free spines. Spines also supporting the first rays of the anal, and one to the ventral fins. This order comprehends numerous families of the ordinary fishes, among which are,—

Percoides—perches.
Buccæ Loricatæ—mailed cheeks, gurnards.
Squamipennes—chætodon.
Scomberoides—mackarel, sword-fish.
Theutyes—sturgeon.
Mugeloides—mullet.
Gobioides—blenny.
Laberoides—laberes.

ORDER II. MALACOPTERYGII ABDOMINALIS, Soft Finned.

169. Distinguished by the position of the ventral fins, which are suspended to the under part of the belly behind the pectorals, without attachment to the bones of the shoulder. The genera is numerous, and comprehends most of the fresh water fishes.

Salmonides—salmon, trout.
Esoces—pike, flying-fish.
Caprinidæ—carp, cobitis, anableps, *Clupeæ*, herring.
Seluridæ—electric eel.

ORDER III. MALACOPTERYGII SUBRACHIATA.

170. Ventral fins inserted under the pectorals, the pelvis directly suspended to the bones of the shoulder.

Gadus—cod, haddock, whiting.
Discoboli—lump-sucker, remora.
Plani—(*pleuronectes*, side swimmers) plaice, flounder, sole.

ORDER IV. MALACOPTERYGII APODES.

171. Elongated slender body; no ventral fins; thick skin; small opercula opening by a hole or tube.

Anguilliformes—eel, conger, gymnotus, ophidia.

ORDER V. LOPHOBRANCHII, Tufted Gills.

172. Gills divided into small tufts, arranged in pairs, and covered by a large operculum, with a single orifice; body covered with shield-like plates. Species generally small, with thin muscles.

Syngnathus—hippocampus, pegasus, solenostomus.

ORDER VI. PLECTOGNATHI.

173. With imperfect bony skeleton; and, as the name implies, cheeks united by a suture. Opercula concealed under a thick skin; no ventral fins. Some of the genera, as the cephalus, seem as if the body were cut off by the shoulders.

Diodon—porcupine fish.
Tetraodon.
Ostracion—file fish.
Cephalus—sun fish.
Triodon.

The porcupine fish have large air bags; and when fully inflated, their bodies are rendered so buoyant as to float on the surface of the water. Their thick covering of sharp spines guarding them against the attacks of enemies.

CHONDROPTERYGII, Cartilaginous Fishes.

174. The fishes of this division have a cartilaginous skeleton, the calcareous matter being deposited in small grains. Cranium formed of a single piece, without sutures or joinings. In some the branchiæ are free; in others fixed, and communicate externally by holes.

The order with free branchiæ comprehends,—

Accipenser—sturgeon.
Chimæra—arctic chimera.
Spatularia—paddle fish.

The second order with fixed branchiæ includes,—

Selachii—shark.	*Raia*—ray, skate, torpedo.
Zygæna.	*Squatina*—angel fish.
Prestis—saw fish.	*Petromyzon*—lamprey.
Myxine.	

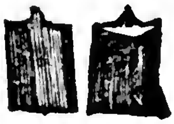
175. M. Agassiz has classified fishes according to the form of the scales, and thus divides them into four orders.

No. 29.

1. Placoidian. *Broad plated.*

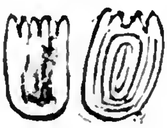
Skin irregularly covered with enamelled plates, often of large size. Sometimes small points like shagreen. This order comprehends all the cartilaginous fishes of Cuvier, except the sturgeon.

2. Ganoidean. *Shining scales.*



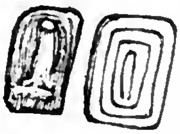
Enamelled scales, with brilliant surface, angular, rhomboidal; formed of horny or bony plates. Of the sixty genera of this order, fifty are fossil and extinct.

3. Ctenoidean. *Comb shaped.*



Scales pectinated on their posterior margin like the teeth of a comb, laminæ of horn or bone, but no enamel, as the perch. This order comprehends the acanthoptyregii of Cuvier, with the exception of the smooth-scaled families, and with the addition of the pleuronectes, or flat fish.

4. Cycloidean. *Circular.*



Scales smooth, with a simple margin, and frequently ornamented or indented with various figures or patterns on the upper surface. Laminæ of horn or bone, without enamel. Embracing chiefly the malacoptyregii of Cuvier.

SECTION XVI.

DIVISION II.—MOLLUSCA, Soft Animals.

176. In this division of animals there is no skeleton nor vertebrated canal. The body is composed of soft parts, in some unprotected except by skin, in others covered with a shell.

The nervous system consists of certain ganglionic knots dispersed in different points, the chief of which, corresponding to the brain, is around the œsophagus. These ganglions form a circle with more or less complete connection.

The respiratory organs are diversified; some breathing air with organs resembling lungs, others being furnished with branchiæ, and inhaling fresh or salt water.

They have a heart, and double circulation, with white or bluish coloured blood, thinner and containing less fibrine than that of the vertebrata. Their stomachs are various, either simple or compound, and they have the liver generally largely developed.

Their muscles are attached to their skin or to the shelly coverings in which they reside, and admit of contractions and relaxations, by which various degrees of locomotion are produced, but they have no limbs for extension or sudden movements.

They have great irritability, which remains after the body has been divided into pieces. The skin is naked and secretes a mucilage from its pores.

Almost all these animals have a prolongation of the skin, which covers part or the whole of the body, called a *mantle.*

The naked mollusca are those in which the mantle is small and narrowed into a simple disk, or pipe, or sac, or divided in the form of fins.

Those which have the mantle more largely developed are covered by it and are called *testaceous* or shell mollusks.

Shells are of various forms and colours according to the families to which they belong. They are composed of carbonate of lime, or of albuminous or horny matter, and are formed by an exudation from the skin of the animal, either in parallel and successive laminæ or in crowded vertical filaments. These shells are generally unconnected with the animal, and yet they are increased in growth, and repaired, when damaged, by a secretion similar to that of the nails, claws, or hair of other animals. Shells are either univalve or of one piece, simple or whorled; bivalve, divided into two halves and hinged at the umbo; or multivalved, having more than two parts, and connected by membranes. The mouths of many of the whorled shells, as the snail, are covered by an operculum formed either of horney or calcareous matter.

177. The number of the senses possessed by the various orders of the mollusca is very irregular; a few only have eyes, still fewer have the sense of hearing. The organ of smell is not present in any of the class, yet it has been supposed they have the perception of odours through their porous skin. Touch and taste are the senses possessed by the whole in common. Their instincts are extremely limited, and their developments are for the most part confined to the mere organic functions necessary for existence.

Their fecundity is great. Some are viviparous, producing their young with the shell already developed; others are oviparous. In some the two sexes are contained in the same animal.

CLASS I.—CEPHALOPODA, Legs on the Head.

178. The mantle unites to form a muscular sac containing the viscera. The head is surrounded by arms or tentacula, provided with suckers. A heart, with two ventricles; respire by branchiæ; mouth with horny jaws; two eyes; ear; swim with the head backwards, and move in all directions with the head undermost.

No. 30.

a the tentacula surrounding the head;
b the stomach and intestinal canal;
the dotted body, the liver;
c the anus;
d the heart and branchiæ.

The genera are:—

Sepia, cuttle fish.	*Bellemnites*.
Nautilus.	*Ammonites*.
Argonauta.	*Nummulites*.

The cuttle fish is remarkable for its ink-bag containing a carbonaceous fluid, which it emits when pursued in order to darken the water and aid its escape. The argonauta inhabits a light shell, and erects two membranes for sails. The nautilus has a hollow multilocular, or many-chambered shell, and a siphuncle penetrating these cells, by which it modifies the pressure on the contained air, and renders its shell lighter or heavier than water, by which means it sinks to the bottom or floats on the surface of the ocean. The bellemnites and ammonites are extinct families.

CLASS II. — PTEROPODA, Fin Legs.

179. Bodies formed like a sack, but without tentacula. Two fins placed on each side of the mouth, by which they swim. Branchiæ, a vascular net-work in the fins: indistinct eyes. The *clio, cymbulia pneumodermon*, are the few species known.

CLASS III. — GASTEROPODA, Belly Walkers.

180. A fleshy disk under the abdomen by which they crawl; mantle on the back, covered, in most genera, by a shell. Head with from two to six tentacula; eyes on the head, or at the points of the tentacula, or awanting. A single heart; some respire air, others have aquatic branchiæ.

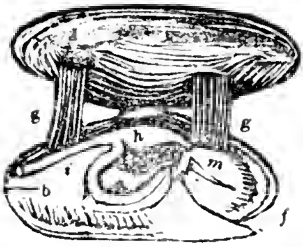
Organs of digestion various. A numerous class, divided into orders according to the position and form of the branchiæ; including, —

Pulmonea — snails.
Nudibranchiata — doris, triton, thetis.
Pectenibranchiata — trochus, buccina, murex, &c.
Scutibranchiata — halyotis.
Cyclobranchiata — patella chiton.

CLASS IV. — ACEPHALA, Headless.

181. Without heads; a mouth concealed in the folds of the mantle; the mouth doubled like the leaves of a book, with the body between; the branchiæ fringed; the heart simple; the ovaries beside the fringe of the branchiæ; covered with a bivalve or multivalve shell, furnished with a strong muscle to shut the shell; some with a foot for locomotion.

No. 31.



h the heart; *m* the mouth; *i* the intestine passing through the blood-vessel; the white sack in the centre is the stomach surrounded by the liver; *b* the fringed branchiæ; below is the ovary; *f* the foot; *g g* powerful muscles which open and shut the two valves of the shell.

This is a numerous class, among which will be found the following genera :—

Ostracea — oyster, pecten, pinna, avicola.
Mytilacea — muscle, crassatella.
Chamacea — chama, tridacna.
Cardiacea — cockle, donax, cyclas, venus.
Inclusa — solen, pholas, teredo.
Acephala nuda — ascidi, pyrosoma.

Many animals of this class are prized as food. In the oyster and muscle pearls are found. The *byssus*, or silken threads of the muscle, are filaments by which the animal anchors itself to stones. The pholades have the power of boring conical holes in shale and hard rocks. They are furnished with a fleshy proboscis, and it is a matter of doubt whether these perforations are made with this instrument, aided, as in some species, by an acid secretion, or whether they are produced by the serrated surface of the shell.

CLASS V.—BRACHIOPODA, Armed Legs.

182. Body with a double mantle; furnished with two fleshy arms, with numerous filaments; the mouth, between the base of the arms, covered with bivalve shells, fixed to one spot. Only three genera,—*Lingula, terebratula, orbicula.* Numerous species of the terebratula are now extinct.

CLASS VI.—CIRRHOPODA, Brush-Legged.

182. Body enveloped by a mantle, and covered with testaceous pieces; mouths with lateral jaws, and abdomen furnished with numerous pairs of cirri; heart situated at the back, and branchiæ on each side; approaching, in structure, some of the crustacea of next division. There are two genera,—*anatifa*, barnacles, and *balanus*.

SECTION XVII.

DIVISION III.—ARTICULATA, JOINTED ANIMALS.

184. The animals of this division have an external covering, which may be called their skeleton, and their bodies and limbs are divided into joints or articulations. Like the vertebrata, their power of locomotion is great, and they can leap, run, and fly; a few families only, with soft bodies, being restricted to crawling on the ground. The nervous system is confined to a chain of ganglionic knots, a rudimentary brain being found around the œsophagus. The circulation is in some carried on by a simple heart, and the respiration by branchiæ; in others a dorsal vessel contains the blood, which is aerated by means of air tubes, with holes or stigmata, opening on the external surface; a few have red, the others white blood. The jaws are lateral and move from without inwards. There is no organ of smell; but the other senses are possessed either in whole or in part, by the different classes of the division. There are four classes of the articulata.

CLASS I.—ANNULATA, OR RINGED.

185. These are red blooded, and the circulation is carried on by a heart, and bloodvessels. The branchiæ extend over the body, or they are placed towards the head. The body is elongated, and divided into numerous rings; the first ring containing the mouth and the organs of sense. There are no jointed feet, but in their place setæ or bristles. The body is naked, or protected with a sheath formed of shell or extraneous materials. The animals are chiefly aquatic, with the exception of the earth-worm. There are three orders,—

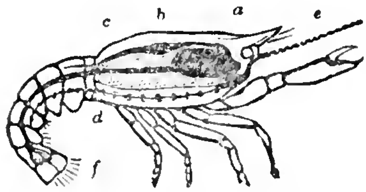
Tubicula—serpula, sabella, terebella, amphitrite.
Dorsibranchia—nereis, aphrodita.
Abranchia—earth-worm, nais, leech, gordius.

The calcareous tubes of the serpula, are seen covering rocks, stones, and the shells of other animals. The terebella burrows in the sand of the sea shore, and collects around its glutinous sheath, fragments of sand, shells, and sea weed, for its protection. The aphrodita aculeata, is beautifully tinged with vivid colours. The earth-worm is deprived of most of the senses, yet its touch is exquisite, and it has instincts which guide it to its food, and enable it to construct a nest of small pebbles, straw, and wood, at the entrance of its hole. The leech has a series of stomachs, and although its usual food is water, and the minute substances it contains, it also pierces the skin with three cartilaginous teeth, and sucks the blood of animals.

CLASS II. — CRUSTACEA, Shell-covered.

186. These animals have a jointed body, and jointed feet, covered in whole or in part with a series of plates of calcareous substance, enveloping the body and limbs, while the muscles and soft parts are contained within. The heart *b* is situated on the back, and communicates by vessels with the branchiæ, which are placed either below the body, at the base of the legs, in the form of laminæ, or tufts, or on the legs themselves, or tail, as at *f*. The mouth is furnished with palpi, which serve as lips; the stomach *a* is seen in the centre, surrounded by the liver, (the dotted part,) and terminates in the intestinal tube, which passes on to the tail. The nervous system, composed of a chain of ganglions, is situated below the viscera, as seen at *d*. The antennæ *e* project in front, and are organs of touch, and, perhaps, smell. The eyes are situated on a jointed moveable pedicle. They are generally carnivorous, and live, with few exceptions, in the water. In the crab, lobster, &c. three teeth are found within the stomach. They change their calcareous shells several times in course of their life, and have the singular power of renewing lost limbs.

No. 32.



187. *The malacostraca* have a solid and entire covering of shell with ten or fourteen feet, the two large anterior ones furnished with opposing claws. The ova are attached to the exterior surface of the abdomen. The crab, lobster, land crab, &c. belong to this subdivision.

The hermit crab has the posterior part of its body uncovered, and takes possession of any empty shell it can find, as a protection, and which it occupies as a house.

The annual migration of the land crab, from the mountains to the sea shore, in order to deposit its spawn, is a curious manifestation of the instincts of animals.

188. *The entomostraca*, or insects with shells, are so minute, as to be almost invisible to the naked eye. They are covered with a thin shell, of one or two pieces; have numerous feet fitted for swimming, and their integuments partake of the horny composition of insects. They have two, or more frequently one, eye. They are aquatic, and generally fresh water animals. Among the genera are,—*Monoculus, nicothoe, limulus*, and the fossil trilobites.

CLASS III.—ARACHNIDES, SPIDERS.

189. The arachnides are distinguished from insects, which in several respects they closely resemble, by their respiratory organs. These are situated under the abdomen, and consist, in one class, of a heart and sacs corresponding to lungs communicating with the air by stigmata; and in the other, of tracheæ or tubes opening by two stigmata near the anus, and without a heart.

The animals of this class have no wings, but generally eight legs, terminated by hooks. They are oviparous, but undergo no change of form like insects, merely casting their skin. The head can scarcely be distinguished from the thorax. They have two organs in front, corresponding to imperfect antennæ, which they use as mandibles to seize and break down their food. Their eyes (*oscelli*) are of simple structure, and vary from eight or more, to four or two. Sometimes they are so extremely imperfect, as almost to disappear. The spiders feed on insects, or larger animals; other species are parasitical, living on the bodies of larger animals, and some, as mites, live on cheese, some on vegetable matter.

No. 33.

190. The Pulmonaria respire by lungs; the stigmata, from two to eight, opening in the posterior and lower part of the abdomen. They have eight legs, and from six to eight eyes. The mouth is armed with two palpi like claws. There are two families.

Araneides — spiders *Pedipalpi* — tarantula, scorpion.

The spiders are a numerous and curious family. They have two little bags in the hind part of the abdomen, which secretes a fluid from which their webs are spun, and which is of the same nature as silk. The openings of these bags are pierced by several minute orifices, and the slender threads join into one immediately after exposure to the air. With these cords they construct a circular web, divided into numerous meshes, by which they entangle flies, on which they prey. The female also envelops her eggs in a bag of this silk.

The gossamer threads seen so plentifully glittering in an autumn sun, are supposed the first spinnings of the young *lycosæ*, a family of spiders, of which the tarantula, or poisonous spider of Italy, is a member.

All the spiders secrete a poisonous fluid, which, by their bite, they instil into their victims when these are found too large or powerful for their slender toils. The *mygale* family are the largest, some of them covering a circular space of from six to seven inches in diameter. Some of these are a match for humming-birds and small pigeons. They live in silk-lined cases, and holes under stones, and in the bark and leaves of trees. Scorpions have an elongated jointed body and legs, with claws not unlike the crustacea. The tail is six-jointed, long and slender, and at the tip is a sting through which issues a poisonous fluid, capable of producing alarming and serious effects on the human body.

191. The TRACHEARIÆ are distinguished by their respiratory organs, being composed of branching tubes, which convey the air to their blood, and are destitute of true circulating organs. They consist of

Galeodes — pseudo scorpion	*Phalangium*
Pycnogonum	*Acarus* — mite

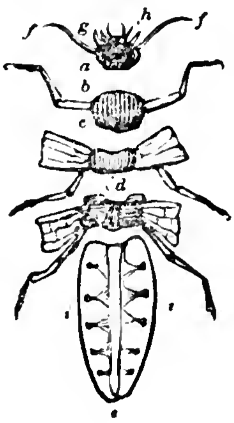
The acari are a numerous family, many of which are microscopic. They are found under stones, in wood, dried meat, cheese, and in the skin and flesh of living animals. The pustule of the itch is caused by a minute animal of this kind. Cheese mites are oviparous, and excessively prolific. Their young are produced with six legs, other two growing out afterwards. The *ixodes*, or ticks, fasten their hooked mouth and necks into the skin of dogs, foxes, and cattle, and increase so as often to destroy the animals.

CLASS IV.—INSECTA, Insects.

192. Insects are so called from their bodies being divided into several distinct parts or segments. They form the most numerous class of animals, the amount of species already

known exceeding one hundred thousand. From the peculiarities of their structure, the successive changes or metamorphoses which they undergo, the singular instincts which they exhibit, and the brilliancy and beauty of colour which many possess, they have always claimed the particular attention of the naturalist.

No. 34.



a the head ;
b prothorax ;
c mesothorax ;
d metathorax ;
e dorsal vessel extending along the abdomen ;
i i stigmata, with vessels leading to the tracheæ ;
f f antennæ ;
g mandibles or jaws ;
h palpi or lips.

With the exception of one family, *myriapoda*, the body of insects is divided into three parts ; the head, *a*, on which are the antennæ, eyes, mouth, and palpi ; the thorax, or corslet, composed of three parts, *b*, *c*, *d*, to which are attached the legs and wings ; and the abdomen, *e*, *i*, *i*, in which are contained the viscera and respiratory apparatus. Insects have no heart ; but in place of it a dorsal vessel, *e*, running along the back, which contains the white blood of their bodies. The air is admitted to this fluid by stigmata or holes on each side of the abdomen, *i*, *i*, from which ramify minute vessels, joining two larger branchiæ, which traverse the whole length of the body. The stomach varies much in the different families, as well as the intestinal canal. Connected with the digestive apparatus are hepatic vessels and salivary glands.

The mouth is furnished with *mandibles*, *g*, or jaws, and jointed filaments called *palpi*, *h ;* two jointed antennæ or *feelers*, *f*, *f*, of various forms in the various families, also project from the head. Many insects are furnished with a proboscis or trunk.

The nervous system of most insects consists of a small rudimentary brain, and a double ganglionic chain, extending along the inferior part of the body. From this chain forty-five pairs of nerves are sent off to all parts of the system. It is probable that many insects possess equivalents for all the senses, although distinct organs of smell or hearing are not visible. Besides being very delicate organs of touch, the antennæ are supposed by some to communicate the impression of odours. The eyes are numerous in insects, and of various forms; some being extremely simple, others compound. In many the cornea is divided into numerous facets, each of which is supposed to admit of distinct vision.

The wings of insects are formed of two layers of extremely thin, dry, and elastic membrane: these are supported by branched nervures, which intersect them in all directions, and often form beautiful net-work. These veins or nervures are hollow tubes, and serve to convey air to the juices of the animal in the same way as the tracheæ of the abdomen. The wings of the butterfly family are studded with extremely minute scales of all varieties of colour; they are attached to the membrane of the wing by a pedicle, and are ranged like tiles on a house. Insects have either four or two wings.

The feet are jointed, and consist of a thigh-bone, tibia, or leg, and tarsus, or toes: these latter are either hooked, or contain hollow suckers. The generality of insects have six feet; the myriapoda, which have a great number, forming an exception.

193. Insects are sometimes viviparous, but in general the young are hatched from ova. These young, when first produced, are of a different form altogether from the parent; and it is only after undergoing successive changes, that they acquire their full development. This is called their metamorphosis; a process which the greater number of insects pass through, and which is more or less complete in the different species.

No. 35.

a b

The egg being deposited by the parent in a suitable situation, produces a worm without wings, which is called the *larva* or grub, *a*: the animal has a head and mouth, and the rudiments of palpi, but no antennæ: the body is divided into numerous joints, either with or without feet. The stigmata or air-holes are situated on each side of these divisions. After feeding for a certain period, and increasing in size, the larva now changes to the *chrysalis*, *pupa*, or *nymph*, *b*, where it is enclosed in a hard sheath, sometimes covered with mucous incrustations, or a silky

No. 36.

c

cocoon. In this condition it remains without food for several weeks or months, possessing the form of the perfect insect, but with all its parts folded up; till at last, bursting its sheath, it comes forth a winged animal, called *imago, c.*

After pairing with its mate, and enjoying existence in this new state for a limited period, it deposits eggs for future larvæ, and then dies. Nothing can be more singular than the metamorphoses which many insects thus pass through. Some aquatic larva, as the gnat and ephemera, live for a year or two in water, and then changing their form, mount into the air as winged insects: others, as the œstrus or gad-fly, are hatched in the intestines of the horse or cow, and then become winged hornets; while the cynips of the oak lives in a vegetable ball, known as the nut-gall, previous to its passing into the form of a fly.

The changes of other insects are less complete: some merely cast their skins, and assume wings; while others undergo no change of form.

The instincts of the insect tribes are generally highly developed. They shew great ingenuity in constructing their houses and nests, and labour the best part of their short existence in providing for their future young, which, however, few of them are ever destined to behold, as their life terminates before the slow evolution of their offspring. The joint labours of insect communities are also of a wonderful nature; their wars and foragings, their attachments and dislikes, the precision with which, in long flights, they distinguish places, and fly in straight lines to them, the acuteness of their senses, and certain modifications of these, apparently different from those of the higher animals, are all matters of singular interest connected with their history.

The metamorphosis of insects seems to be an adaptation to suit such delicate beings for the annual changes of temperature and the successive appearance of the plants and flowers on which they feed. They are to some extent migratory; yet species are for the most part circumscribed within definite geographical limits; and every zone has its own peculiar insects. In tropical regions the insect tribe are most numerous, and have the greatest brilliancy of colours.

The sounds of insects are produced by the vibration of their wings, or by striking their legs or palpi against wood or their own horny bodies.

194. Almost every organized substance becomes the food of insects; some living on vegetable, others on animal matter. There is not a plant that has not several insects which feed on some part of it; and no preparations of animal or vegetable matter, in whatever condition or state of decay they may be, are safe from the all-devouring appetites of the myriads of winged beings, which are continually swarming in the earth or in the air.

In this way insects are of service in ridding the earth of matters which would be offensive and deleterious to other beings; while they themselves, on the other hand, afford food to many kinds of birds, reptiles, and fishes.

The insects of direct use to man are, the honey-bee, the silk-moth, cochineal-fly, that furnishes the scarlet dye, the blistering-fly, and the locust, which is eaten by some nations.

195. Cuvier divides insects into twelve orders, founding his distinctions on the presence or absence of wings, and on their form and texture.

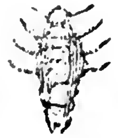
No. 37.

196. ORDER I. MYRIAPODA. *Centipedes.* Body without wings, elongated, and composed of a number of equal sized joints, with two pair of feet proceeding from each. These feet amount to twenty-four and upwards, and increase in number with the age of the animal. Undergo no metamorphosis. The *julus*, *glomeris*, and *scolopendron*, live under stones, and in sandy places.

No 38.

197. ORDER II. THYSANOURA. Wingless insects, with six feet and a tail, or appendages like feet to aid them in leaping. They undergo no metamorphosis. The *lepisma* is found in crannies of old wood; the *podura*, a minute black insect, is frequently seen in great numbers on the surface of stagnant waters.

No. 39.

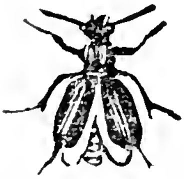


198. ORDER III. PARASITA. Without wings; six legs; undergo no metamorphosis; are parasites living on the bodies of other animals. There is only one genus, *pediculus*, or louse, including many species which attach themselves to the skins of animals, feed on the blood, and deposit their glutinous eggs on the integuments or hair.

No. 40.

199. ORDER IV. SUCTORIA. Without wings; the mouth composed of three pieces, which unite to form a hollow proboscis; undergo a metamorphosis; hind legs strong, and formed for leaping. The various species of fleas form the sole family of this order.

No. 41.



200. ORDER V. COLEOPTERA. With four wings, the upper part hard and crustaceous, joining in a straight line along the inner margin, formed for protection, and called *elytra*. The inferior, or true wings, are folded transversely. In some species these are wanting, but the elytra are always present. The antennæ of various forms, and for the most part composed of eleven joints; two mandibles, with one or two palpi in each; two or more compound eyes. The coleoptera undergo a metamorphosis. The larva is a worm with a scaly head; the pupa is inactive, and requires no food; their habitations, and mode of production, varies with the different species. Some are aquatic, some carnivorous, and others live on vegetables.

This order is by far the most numerous of the insect tribe; and the variety of forms, lustre, and beauty of the different families, render it one of the most interesting. There are four divisions marked out by the number of joints in the tarsi, and the form of the antennæ.

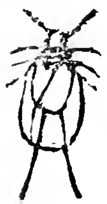
The various kinds of beetles, the dytisci, or water beetles. the blistering fly, the lady-bird, the glow-worm, fire-fly, and numerous others, belong to this order.

No. 42.

201. ORDER VI. ORTHOPTERA. With soft, semi-membranous elytra, and straight wings, folded longitunally, with longitudinal nervures. Undergo a semi-metamorphosis. All the genera are terrestrial, some are carnivorous, the greater number feed on vegetables.

There are two families. The *cursoria*, with legs formed for running, as the cockroaches, mantis, ear-wigs. The *saltatoria*, with large hind legs and thighs adapted for leaping, as the grasshoppers, locust, mole cricket.

No. 43.

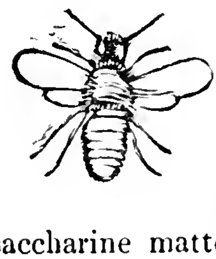


202. Order VII. Hemiptera. Having elytra half membranous. The mouth destitute of mandibles or palpi, but furnished with a sucking apparatus, composed of four pieces. They undergo no metamorphosis. The cimex, or bug, the cicadæ, the aphis, and the cochineal insect, belong to this order. The numerous family of aphides, or plant lice, are gregarious, and are found in great numbers on plants, the succulent juice of which forms their food. Some of these have wings, and others are wingless. During the first part of the season, all the young produced are females, and males only make their appearance towards the end of summer.

No. 44.

203. Order VIII. Neuroptera. The body elongated, with soft integuments; four wings, traversed by a network of nervures, with extended mandibles and straight palpi; the joints of the tarsi generally entire: the antennæ setaceous. Divided into three families, many of which are carnivorous; some undergoing complete, and others imperfect metamorphosis. The libellula, or dragon fly, the ephemera, or day fly, the ant lion, the termes, or white ant, and phryganea, or caddis flies, belong to this order. The libellula, or dragon fly, may be styled the lion of insects. It hovers in the air, with its large glittering wings, and darts upon smaller flies with great velocity. The larva of the ephemera is an aquatic animal; the imago rises from the water in the evening, and only exists in this last state for a few hours. The caddis worms are also aquatic, and construct houses for their tender bodies of straws, wood, and empty shells. The ant lion forms a pit to entrap its prey. The white ants construct large and curious nests, and are voracious and destructive animals.

No. 45.

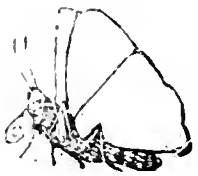


204. Order IX. Hymenoptera. Furnished with four membranous wings, but less reticulated than the neuroptera. The female furnished with a sting, or an ovipositor. They undergo a complete metamorphosis. The larva of some are carnivorous, others live on vegetables, and the perfect insects on the saccharine matter in the nectaries of flowers. The ichneu-

mon, cynips, &c. furnished with an ovipositor, by which they pierce wood, and other bodies, to deposit their eggs, form one division; the ants and bees constitute another, and are remarkable for their habits, for their varieties of sex, and their living in communities.

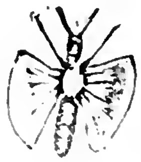
205. ORDER X. LEPIDOPTERA. With four broad wings, covered on both sides with minute scales, often of brilliant colours. Mouth furnished with a proboscis, which rolls up circularly; palpi very small; antennæ of various forms, and jointed. They pass through a complete metamorphosis. The larvæ are known as caterpillars. These larvæ live on leaves, wood, woollen stuff, fur, leather; they change their skins four times before passing into the chrysalis form. Many spin a cocoon to enclose themselves, formed of silk or mucilage, mixed with raspings of wood, leaves of trees, or earthy matter. Some remain in this condition only a few days, two generations being produced in a season. Others lie in the pupa state during the winter, and part of the spring, and come forth exactly at the period when the particular plants on which they feed, and deposit their eggs, are in perfection. In this order there are three divisions, — the *diurna*, including the butterflies, which fly about, and feed during the day; the *sphinxes*, which generally appear in the morning or evening; and the *nocturna*, or moths, which only make their appearance in the evening, and during the night. The beauty and variety of these insects, and the perfect manner in which they may be preserved, cause them to be highly prized by collectors.

No. 46.



206. ORDER XI. RHIPIPTERA. With fan-like wings, and the rudiments of elytra on the anterior extremity of the thorax; mandibles lancet-shaped; two large eyes, and filiform antennæ. The larvæ live on the bodies of wasps. There are only two known genera,—*stylops* and *xenos*.

No. 47.



207. ORDER XII. DIPTERA. Insects with two membranous wings, and two moveable bodies above these, called *halteres*. A proboscis, or sucker, composed of from two to six pieces. Tips of the legs furnished with two hooks, and frequently with concave suckers.

No. 48.

Undergo metamorphoses. The larvæ are without feet. The gnats, mosquitoes, tipula hornets, gad flies, house fly, all belong to this order. They feed on fluids, the juices of animal bodies, putrid flesh, and many pierce the skin, and suck the blood of living animals. The flesh fly is very prolific, and the larvæ come to maturity in a few days; they are voracious feeders, too, and thus whole carcasses are consumed by them in so short a space of time, that Linnæus has remarked, that a few of them will consume a dead horse as quickly as would a lion.

The larvæ of the gnat are aquatic animals, and may be seen in summer floating in myriads, in lakes and rivers, the body being covered with numerous setaceous filaments, which are the branchiæ.

SECT. XVIII.

DIVISION IV.—RADIATA.

208. This last division of animals embraces several classes which cannot well be brought under one definition, except in thus far, that they partake of the simplest structure of the descending scale of animated existence.

The term radiated is intended to express a form of the nervous system, in the greater number, in which the nervous filaments radiate from one or more centres, while *Zoophytes* expresses the plant-like form of the other classes, in which, for the most part, a distinct nervous system is not perceptible.

With the exception of a few of the echinodermata, no traces of a circulating vascular system, or of respiratory organs, are perceptible. In the greater proportion there is a mouth with a stomach, or series of stomachs, an intestinal tube, and an ovary for the production of ova. In some the body is simply a sac or stomach, with or without an orifice, corresponding to a mouth; while, in the polypes, the stomach forms a hollow in the gelatinous mass of the body.

The senses are confined to those of touch and taste, and in the very lowest tribes, little more than the irritability of vegetables is manifest.

CLASS I.—ECHINODERMATA, Spine-Skinned.

209. These animals are covered with a skin, and frequently supported by a sort of crustaceous skeleton, furnished with

moveable spines, which act as arms or suckers. There is a mouth in the centre leading to a series of stomachs, and an intestinal tube; a vascular system communicating with an intestine, and respiratory organ; and nervous filaments traversing the body.

No. 49.

The asterias, or star-fish, is an animal illustrative of this class, with a radiated body, and mouth in the centre. The number of the rays vary in the different species. In these rays are contained the viscera. The whole surface of the skin is porous, and the under side, where is situated the mouth, is studded with moveable suckers, or tentacula, by which the animal seizes its prey and moves from place to place. These animals have such powers of reproducing lost parts, that whole rays, when torn off, are speedily renewed; and even a single remaining ray will reproduce all the others.

The *echinus*, or sea-urchin, is another well known animal of this class. It is protected by a globular shell with spines; the mouth is in the centre, and is furnished with five teeth inserted into a five-sided frame of calcareous matter. The intestine is voluminous and attached spirally to a membrane lining the shell. The ovaries are also very large, and form the eatable part of the animal.

The *spatangus* has an irregular heart-shaped shell, covered with very small spines, divided interiorly into four or five unequal compartments.

The *encrinite* has a jointed stem, which is fixed to a rock, with numerous smaller jointed tentacula at the top surrounding the mouth, in the centre. Many extinct species of these are found in a fossil state.

Another order of this class, the *apoda*, are without spines, their bodies having a coriaceous covering. The *siphunculus* has an elongated cylindrical form, and burrows in the sand of the sea-shore.

CLASS II.—ENTOZOA, Intestinal Worms.

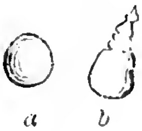
210. This class of animals, of which there are about a thousand species, live within the bodies of other animals, and are found in the brain, liver, intestines, and even the heart and blood-vessels. In these localities they live and propagate, and cannot exist in any other situation. Many animals have pecu-

liar species of these worms which are found in no others. How the ova are transmitted from one individual to another has been a circumstance so difficult to explain that some theorists have resorted to the idea of equivocal generation, contending that these animals have sprung from the living fibre of the cavities in which they reside. All the analogies of nature, however, and the fact that these entozoa, even of the simplest structure, have ovaries, and produce abundance of ova, entitle us to suppose that they, in common with all other organized beings, spring from a parent of the same species.

Of these animals there are two divisions :—

NEMATOIDEA, with an intestinal canal, mouth, anus, and generative organs, as the *filaria*, or guinea-worm, the *ascaris*, or round-worm, *oxyuris*, *strongylus*.

No. 50.

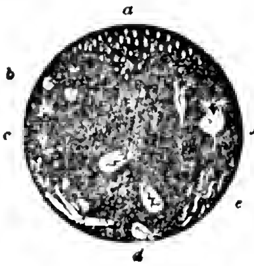


PARENCHEMATA, body of cellular substance, with ramified canals, and covered with a skin with a mouth or sucker, or a stomach with or without a mouth, as the *tænia*, or tape-worm, *fasciola*. *Hytadid*, *a*, *Cysticercus*, *b*.

CLASS III.—INFUSORIA, INFUSORY ANIMALCULES.

211. The animals of this class, although so minute as to be invisible to the naked eye, yet have been ascertained to possess an organization more complicated than some of those we have just enumerated. They are called infusory, because it is chiefly in infusions of vegetable matter that they are discovered. If a few stalks of hay, or the leaves or stems of plants, be put into a little water, and allowed to remain for a week or two, a drop of the fluid, especially from that portion where a thin pellicle has been formed on the top, when viewed under a good microscope, will exhibit a little world of active, busy beings, in the full tide of enjoyment. The smallest and simplest forms are the *monads*, *a*, three millions of whom can find room in the circumference of a single drop of water. The *volvox globator* *b* is a s'apeless gelatinous mass, which appears frequently to change its form. *c* represents the manner in which some animalcules multiply, by dividing their bodies into two halves. *d* are three of the *Leucophrys*

No. 51.



patula, a very common and active animalcule, with cirri around the head, and the appearance of an internal stomach, branching into numerous sacs. *e* the *vibrio aceti*, or paste and vinegar eels. *f* the *rotatoria*, or wheel animalcule, so called from several circular cirri around its head, which keep continually revolving.

CLASS IV.—ACALEPHA.

No. 52.

212. These animals have a round gelatinous body, with few indications of an internal organization. They float in the sea by alternate contractions and dilatations of their pulpy substance. The *medusæ*, of which there are several species, varying from twelve inches in diameter, to the minutest point, belong to this class. They are familiar, as jelly-like masses, frequently cast ashore on our beaches. The smaller species are abundant in the arctic seas, and form the principal food of the whale.

The *physalia*, or Portuguese man-of-war, rendered buoyant from its bladder shape, floats along the surface of the sea, forming its crest into a sail.

CLASS V.—POLYPI.

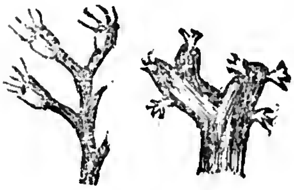
213. A singular and numerous class of animals, having a cylindrical or conical body, with tentacula surrounding the mouth. The stomach is a hollow in their gelatinous body, and the mouth generally serves as an anus. They multiply by sending off shoots or buds from all parts of the body except the tentacula. There is a simple ovary also which produces ova at certain periods.

The *actinia*, or sea anemony, is fixed to rocks by its fleshy body. It is often brilliantly coloured, and the expansion or retractation of its numerous tentacula alters its shape and appearance. When fully expanded, it resembles a flower—hence its name. There are of these numerous species.

No. 53.

The *hydra*, or fresh water polype, is found attached to leaves and reeds in slow running streams. It moves about by bending its body, or using its tentacula, which are capable of elongation to the extent of several inches. With these it seizes on worms, on which it feeds. Their bodies, when cut into pieces, soon assume as many new forms. They can also be turned outside in, without suffering any inconvenience. After swallowing their food, and extracting its nourishment, they void the indigestible parts by the mouth. They are stimulated and attracted by light, and are active and voracious little animals.

No. 54.



a b

The *coraliferi* include the *sertularia*, *a*, *tubularia cellularia*, *corallina*, *b*, *flustra*.

These polypes inhabit cells formed of carbonate of lime. They are gregareous ; the young forming their cells above the parents, and thus, in the course of years, a branched plant-like substance is produced, well known as coral.

In tropical seas, these coral zoophytes form reefs of thousands of miles in extent.

Our ancient limestone beds appear to have been produced in the same manner, for fossil corallines are found in abundance in such beds.

TABLE OF CLASSIFICATION

DIVISION I.—VERTEBRATA.

MAMMALIA.

- *Bimana*—man.
- *Quadrumana*—monkeys.
- *Carnaria*
  - *Cheiroptera*—bats.
  - *Insectivora*—mole, hedgehog.
  - *Carnivora*—dog, lion, bear.
  - *Amphibia*—seal.
- *Marsupialia*—opossum, kanguroo.
- *Rodentia*—squirrel, mouse, hare.
- *Edentata*—sloth, ant-eater.
- *Pachydermata*—elephant, horse.
- *Ruminantia*—camel, deer, sheep.
- *Cetacea*—whale.

AVES.

TEMMINCK.

- *Rapaces*—eagle, hawk, owl.
- *Omnivores*—crow, magpie.
- *Insectivores*—thrush, wren.
- *Granivores*—lark, bunting.
- *Zygodactyli*—cuckoo, parrot.
- *Anisodactyli*—nuthatch.
- *Alcyones*—king-fisher.
- *Chelidones*—swallow.
- *Columbæ*—pigeon.
- *Gallinæ*—cock.
- *Alectorides*—trumpeter.
- *Cursores*—ostrich, emu.
- *Grallatores*—plovers.
- *Pinnatipedes*—coot
- *Palmipedes*—ducks.
- *Inertes*—dodo.

CUVIER.

- *Accipteres.*
- *Passerinæ.*
- *Conirostres.*
- *Scansoriæ.*
- *Gallinaceæ.*
- *Grallatoriæ.*
- *Palmipedes.*

REPTILIA.

- *Chelonia*—tortoise.
- *Sauria*—crocodile, chameleon.
- *Ophidia*—serpents.
- *Batrachia*—frog, syren.

PISCES.

- *Acanthopterygii*—perch, mackerel.
- *Malacopterygii*—salmon, herring.
- *Lophobranchii*—pipe fish, pegasus.
- *Plectognathi*—sun fish, diodon.
- *Chondropterygii*—shark, sturgeon.

AGASSIZ.

- *Placoides*
- *Ganioides.*
- *Ctenoides.*
- *Cycloides.*

OF THE ANIMAL KINGDOM.

II. DIVISION—MOLLUSCA.

CEPHALOPODA—cuttle, nautilus.
PTEROPODA—clio hyalea.
GASTEROPODA—snail, limpet.
ACEPHALA—oyster, muscle.
BRACHIOPODA—ligula terebratula.
CIRRHOPODA—barnacle.

III. DIVISION—ARTICULATA.

ANNULATA.	*Tubicula*—serpula terrebella. *Dorsibranchia*—nereis, aphrodita. *Abranchia*—earth worm, leech.
CRUSTACEA.	*Malacostraca*—crab, lobster. *Entomostraca*—monoculus.
ARACHNIDES.	*Pulmonaria*—mygale, spider. *Trachearia*—tarantula, scorpion, mite.
INSECTA.	*Myriapodes*—julus, centipede. *Thysanoura*—lepisma. *Parasita*—louse. *Suctoria*—flea. *Coleoptera*— beetles. *Orthoptera*—grasshopper. *Hemiptera*—aphis, bug. *Neuroptera*—dragon fly, ephemera. *Hymenoptera*—ant, bee. *Lepidoptera*—butterfly, moth. *Rhipiptera*—stylops. *Diptera*—house fly, gnat.

IV. DIVISION—RADIATA.

ECHINODERMATA.	*Pedicellata*—star fish, sea urchin. *Apoda*—sipunculus, lithodermis.
ENTOZOA.	*Nematoidea*—guinea worm, ascaris. *Parenchymata*—hydatid, fluke.
INFUSORIA.	*Rotifera*—wheel animal, hydatina. *Polygastrica*—monad, volvox.
ACALEPHA.	*Simplicia*—medusa. *Hydrostatica*—physalia.
POLYPI.	*Carnosi*—actinia. *Gelatinosi*—hydra *Coralliferi*—tubipore, sertularia.

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Shaw's Zoology, 14 vols. plates.
Blummenbach's Manual of Natural History, by Gore, 1 vol. 8vo.
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Pritchard's Natural History of Man.
Pennant's British Zoology, 4 vols. 8vo.
——— Arctic Zoology.
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Temminck Manuel d' Ornithologie, 2 vols. 8vo.
Lamarck Anim. Sans Vertebres, 7 vols. 8vo.
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Ellis's Natural History of Corallines, 1 vol. 4to.
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GLOSSARY.

Abdomen, The belly
Absorb, *Absorption*. The minute mouths of the vessels of the skin and other parts of the body have the power of taking up or absorbing fluids, air, &c.
Albumen, Animal jelly, as the white of egg
Alimentary, Serving as food, belonging to food
Amphibious, Animals which live both in the water and on land
Annulated, Ringed
Annular, Consisting of rings
Antennæ, Two slender bodies placed on the heads of insects and other animals
Articulata, Those animals having a jointed structure, but no proper bones
Articulations, Junctures or joinings
Aurelia, A pupa, the second state of an insect
Bicuspid, Having two points
Bifurcated, Divided into two branches
Bimana, Two-handed
Branchiæ. Gills of fishes and reptiles
Byssus, A beard, common in muscles, pinnæ, &c.
Calcareous, Composed of lime or chalk
Caudal, Relating to the tail
Canine teeth, The sharp pointed teeth on each side of the four cutting central teeth of animals
Carinated, Keeled
Carnivora, Flesh-devouring animals
Carnivorous, Flesh-eating, that of which flesh is the proper food
Carpus, Bones of the hand
Cartilage, Gristle
Cere, A skin which covers the base of the bills of some birds
Chyme, The pulpy fluid when first digested
Chyle, The digested fluid, after an admixture of bile
Ciliated, Edged with parallel hairs, bristles, or appendages, like the eyelids
Cirri, Tendrils
Cirrous, Like a tendril
Class, A term designating one of the principal divisions of the animal kingdom, including orders, genera, and species.
Clavicle, The collar bone
Cocoon, The nest which caterpillars spin for themselves before their transformation into the pupa state
Coriaceous, Like leather
Crustaceous, Consisting of a crust composed of carbonate, and phosphate of lime, and animal matter
Cutis, The under skin
Digestion, The process by which food is converted into nourishment for the body
Dorsal, Relating to the back
Echinated, Bristled like a hog, set with spines
Elongated, Lengthened, drawn out
Elytra, Hard membranous substances covering the wings of various insects, such as beetles, &c.
Enamel, The hard outer covering of the teeth
Epidermis, The outer or scarf skin
Exude, To issue out
Farina, A fine mealy or scaly substance covering the wings of insects
Filament, A small thread
Fluviatile, Of, or belonging to, fresh water
Foliated, Leaved
Fourchette, A fork, hence
Furcated, Branched
Ganglion, A knotted nervous cord
Gelatin, Viscous, stiff, cohesive matter, a jelly extracted from animal substances by solution in water, but not in alcohol
Gemmiparous, Animals that produce young by buds or slips from the body
Genus, Plural *genera*; a family, or kind of animals having a general resemblance to each other, but containing different species
Gills, A series of flaps or thin folds on

each side of the head of fishes, and some other animals, through which water constantly passes; the air which it contains being absorbed or taken into their blood

Gizzard, The strong muscular stomach of birds

Gland, A knot of vessels like an acorn secreting organs

Granivorous, Grain feeding animals

Heart, A strong, hollow, muscular substance, which circulates the blood through the blood-vessels of the body

Herbivora, Those animals which feed on grasses and herbs

Imago, An insect when it has become a winged fly

Incisory teeth, The front cutting teeth in the upper and under jaws of quadrupeds

Infusoria, Animals found in infusions of vegetables and other liquids

Instinct, The power which guides animals in their various operations

Intercostal, Placed between the ribs

Intestinal, Belonging to the bowels

Intestinal worms, Animals living in the intestines of other larger beings

Iridescent, Shining, with changeable colours

Irritability, A contracting of organized fibres, on the application of any stimulus

Lachrymal, Of, or belonging to tears

Lacteals, Vessels in the intestines that convey the chyle

Lamellar, Consisting of films or plates

Laminæ, Thin plates, laid one coat above another

Larva, Grub, or worm, the first stage of an insect before it becomes a fly

Ligament, A solid body, softer than a cartillage, but harder than a membrane, which fastens the bones and articulates them together for motion; in bivalve shells, the substance which connects the valves

Linear, Composed of lines

Littoral, Of, or belonging to the shore

Lungs, Substances consisting of numberless cells, through which the air is breathed that contributes to the life of the body

Mammæ, The breasts or paps of animals

Mammalia, Those animals which have teats, and which suckle their young with milk

Mandibles, The upper and under chaps of a bird's bill, or jaws of an insect

Masticate, To chew the food

Maxillæ, Or jaws

Migration, The flight of birds from one country to another at certain regular periods of the year

Mollusca, Those animals having a fleshy body and no bones

Mucus, A slimy secretion

Multilocular, Many-chambered, consisting of several divisions

Muscles, The fleshy substance on the bones of animals, by which they move their limbs and bodies

Nerves, Small white cords proceeding from the brain, and going to every part of the body, by which sensation is communicated.

Nocturnal, Night-feeding animals

Nympha, Pupa, or chrysalis, the second stage of insect life

Œsophagus, The tube leading from the mouth to the stomach

Operculum. The gill-cover of fishes; a lid, by which some of the univalve and multivalve shells are closed

Order, A term in Zoology, which includes genera and species

Organism, Animal structure

Organized, Bodies having vessels and parts necessary for life

Osseous, Of a bony substance

Ovary, The organ which contains the germs or eggs

Oviparous, Animals that bring forth their young from eggs

Ovipositor, An instrument by which insects deposit their eggs

Ovoviviparous, Animals which produce eggs containing living young

Pachydermata, Animals having thick skins

Palpi, Projections from the lower jaws of insects

Palmated, Webbed, as in the feet of some water birds

Papillæ, Small dots or pimples

Parasitical, Living on some other body

Pectinated, Resembling the teeth of a comb

Pectoral, Relating to the breast

Phosphorescent, Emitting light in the dark

Prehensile, Hanging

Proboscis, A moveable tube attached to the head of several animals, particularly insects

Progression, The act of walking or moving

Pupa, Or nympha, the second stage of insect life

Quadrumana, Having four hands

Quadruped, Having four feet

Radiated, Rayed, furnished with rays

Reptile, A name applied to the class of serpents, frogs, tortoises, &c.

Rete mucosum, The mucous network between the outer and inner skin, which is black in the negro

Retractile, Capable of being drawn back

Rodentia, Animals that gnaw with the fore teeth

Ruminantia, Animals which chew the cud.

Sac, A small bag or pouch
Secretion, The production of animal matters by vessels and glands
Sensation, The power of feeling, seeing, hearing, &c.
Serrated, Like the teeth of a saw
Setaceous, Bristly, covered with bristles
Siphunculus, A cylindrical canal, perforating the partition in many-chambered shells
Skeleton, A frame of bones
Species, Belonging to the same genus or family, but having distinct characters
Spiracles, Air-tubes, leading to the branchiæ of insects
Spine, The back bone
Spinous, Having spines like a hedgehog
Stellated, Starred, consisting of star-like figures
Stimulus, Any thing that excites or acts on the animal frame
Striated, Scored, or covered with fine thread-like lines
Tarsus, The foot bones
Teats, The nipples of animals which suckle their young
Tentacula, Feelers or horns
Testaceous, Consisting of carbonate of lime and animal matter, as in the shells of molluscous animals
Tissue, A thin membrane or web
Thorax, The chest or upper part of the body
Torpidity, A state of sleep that animals fall into during winter, in which they neither eat, nor move, nor have the usual warmth of body
Trachea, The wind-pipe leading to the lungs
Turbinated. Shaped like a top or pear
Umbo, In bivalve shells, the round part which turns the hinge
Unorganized, Matter without any structure necessary for carrying on life
Variety, Is when one species differs in some little degree from that of another
Vascular, Consisting of vessels
Ventral, Belonging to the belly
Vertebræ, The bones which compose the spine or back-bone
Vertebrata, Those animals having a spine, or series of small bones composing the back
Vertebrated, Provided with vertebræ
Villose, } Downy
Villous, }
Viscera, The contents of the internal cavities as the lungs, intestines, &c.
Viviparous, Animals which bring forth their young alive
Zoology, (ζωη and λογος,) a discourse on animals

THE END.

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