A lecture on the advantages of the study of natural history ... : delivered at the city of Westminster Literary & Mechanics Institution, February, 1851 / by Edwards Crisp.

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A LECTURE

ON

THE ADVANTAGES OF THE STUDY

OF

NATURAL HISTORY,

Illustrated by numerous Specimens and Diagrams,

DELIVERED AT THE

CITY OF WESTMINSTER LITERARY & MECHANICS INSTITUTION,

FEBRUARY, 1851.

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ADVANTAGES OF THE STUDY OF NATURAL HISTORY.

[*Illustrated by numerous Specimens and Diagrams.*]

It is scarcely necessary to point out to the members of a literary institution, the advantages of the study of natural history, as they must be apparent to all; but believing as I do, that these advantages are not so much appreciated as they deserve, I have been induced to bring the subject before you this evening, and my object will be, in the short space which is allotted me, to give in as concise and simple a manner as possible, an outline of some of the wonders of the animal kingdom.

As a knowledge of grammar is necessary to the proper understanding of a language, so also is a correct classification essential to the student of natural history. Aristotle, Pliny, and all the older writers failed in their attempts at arrangement from their ignorance of anatomy. Buffon, and many later writers, from the same cause, were equally unsuccessful. Linnæus was the first to arrange the animal kingdom in comprehensive and scientific divisions, but it was left to the immortal Cuvier to improve the system of classification, and to complete that which others had left imperfect. And here I cannot help alluding without some degree of pride, to the members of my own profession who have contributed so much to the perfection of this department of science, in all its branches. I mention some of them—Linnæus, Haller, Pallas, Tiedemann, Daubenton, Sibbald, Barclay, Spix, Withering, Malpighi, Redi, Swammerdam, Blumenbach, Camper, Lamarck, Hunter, Cuvier, Jussieu, Ruysch, Spallanzani, Meckel, Leeuwenhoeck, Geoffroy, St. Hilaire, Shaw, Mandl, Milne Edwards, Owen, Grant, Mantel, and Queckett. Unfortunately, in this country scientific pursuits are generally unrequited by the government, and men are more likely to be rewarded for *political*, than for *literary* services. No people in the world have had such opportunities of cultivating the study of natural history as the English; our ships touch at every port, our countrymen are found in every quarter of the habitable globe, but the government has held out no rewards for scientific labours. We have societies and clubs; companies and private speculations, but nothing *national*. Professor Grant, the celebrated comparative anatomist says, in speaking of France—

> "Every circumstance, to the minutest details, connected with medical education and government, is fixed by legislative decrees, like the other important affairs of the state. The Royal Academy of Sciences, or Institute of France, the Faculty of Medicine of Paris, and the Museum of Natural History, consist of men salaried by government, who have determinate duties, and represent every branch of literature, science, and the arts. They form a striking contrast with our country. In the Budget of the present year, (1841) for instance, there are fifteen professors in the Museum of Natural History alone, with salaries of 5,000 francs each; and in the National Museum of Natural History of England, there never has been a single instructor since the first foundation of the empire."

The improvement, however, that has taken place in the British Museum, both as regards the admission of the public, and the internal arrangements, is a proof that the government is at length awakened to the importance of the subject, and I hope the time is not far distant when we shall have a *National* Museum of Natural History in every

large town in England. I make no apology for this digression, as the subject is one that must especially interest the members of a Mechanics' Institute.

Cuvier has arranged the animal kingdom in four divisions:—1. The *Vertebrate Animals*, or those with an internal skeleton and spinal column. 2. *Mollusca*—Soft, inarticulate, white-blooded animals, without a spine, and often covered with a shell. 3. *Articulata*—Animals that have an external skeleton, and the case which covers their bodies is divided into rings. 4. *Radiata*—Animals, many of which are disposed around an axis.

The vertebrate* animals are divided into four classes—1st. *Mammalia*, comprising—1. *Bimana* or man; 2. *Quadrumana* or monkey-like animals; 3. *Carnaria*, animals without opposable thumbs to the fore-feet, and all of them animal feeders. This class includes the bats, bears, hedgehogs, moles, the dog and cat tribes, and the amphibious animals. 4. *Marsupiata* or pouched animals, as the opossums and kangaroos; 5. *Rodentia*, or gnawing animals, as rats, squirrels, and beavers; 6. *Edentata*, animals without teeth in the fore-part of their jaws, as sloths, anteaters, and duckbills; 7. *Pachydermata*, hoofed animals, including the elephant, hippopotamus, and animals with divided or single hoofs; 8. *Ruminantia*, hoofed animals that chew the cud, and have no incisors in the upper jaw, as the cow, sheep, and deer; 9. *Cetacea*, water animals, without hind limbs.

The birds *(aves)* form the second class of vertebrate animals. They are distinguished by the lightness of their bones, and by the air cells which communicate with these and other parts of the body. They are also oviparous. They are divided into six classes:—1. *Accipitres*, or birds of prey; 2. *Passerinæ*, the sparrow tribe; 3. *Scansores*, the climbers; 4. *Gallinæ*, the poultry; 5. *Grallæ*, the stilt-birds or waders; 6. *Palmipedes*, the webbed-footed birds or swimmers.

The reptiles *(reptilia)* constitute the third class of vertebrated animals—they are cold blooded: a portion of the systemic blood only being sent into the lungs. This class includes,—1. *Testudinata*, tortoises; 2. *Sauria*, lizards, crocodiles, &c.; 3. *Ophidia*, serpents; 4. *Batrachia*, batrachians, as frogs, toads, and salamanders.

The fishes *(pisces)* comprise the fourth class of the vertebrata. They are furnished with gills, and organized for the element in which they move. They are divided into the bony, and cartilaginous: the first order, *Acanthopterygii* or spinous fishes, are very numerous, and are arranged in fifteen families—the perch, haddock, mackerel, dory, and mullet, are found in this order. 2. *Malacopterygii abdominales*, or jointed-fin fishes, consist of five families, which include the greater part of the fresh-water species. 3. *Malacopterygii sub-brachiati*, have the central fins under the pectorals; in the three divisions of this order are the cod, flounder, and sucking-fish. 4. *Malacopterygii apoda*, ventral fins absent; one family; eel-shaped fishes. 5. *Lophobranchii*, fishes with tufted gills, as the pipe-fish; 6. *Plectognathi*, fishes with soldered jaws, including the globe and sun-fishes—these have the power of inflating themselves with air.

The *Chondropterygii* or cartilaginous fishes, (the skeleton not possessing bony fibre) consist of those with free gills, and those with fixed

* I allude to a few familiar examples only, of some of the classes in the four divisions.

gills: the first order comprises the sturgeons; the second the sharks, skates, saw-fish, lampreys, &c.

The *Mollusca*, the second division of the animal kingdom, is distributed into six classes—1. *Cephalopoda*, of which the cuttle-fish is an example; 2. *Pteropoda*, with fins only as the clio; 3. *Gasteropoda*, including the slug, snail, and numerous shell-fish; 4. the *Acephala*, without heads, comprising the oysters, mussels, and cockles; 5. *Brachiopoda;* these have two fleshy arms in place of feet—Lingula; 6. *Cirropoda*, the bristle-footed, as the barnacle.

The *Articulata*, the third division of the animal kingdom, is composed of four classes—1. The *Annelida*, red-blooded animals, most of them aquatic, and tubular; worms, leeches, and worm-shells, belong to this class. 2. *Crustacea*, crustaceous animals, breathing through the skin, and divided into the crustaceous shelled, and thin shelled; as lobsters, shrimps, crabs, crawfish, &c. 3. *Arachnida*, the spider tribe, have air-holes for respiration on the under side of the abdomen; to this class belong also the scorpions and mites. 4. *Insecta*, insects; these, like the last, breathe through spiracles—they have two antennæ or feelers, and only one large vessel, or heart, which extends along the abdomen. They consist of twelve orders—1. *Myriapoda*, centipedes; 2. *Thysanoura*, spring-tails; 3. *Parasita*, lice; 4. *Suctoria*, fleas; 5. *Coleoptera*, beetles; 6. *Orthoptera*, cockroaches, crickets, and ear-wigs; 7. *Hemiptera*, bugs and woodlice; 8. *Neuroptera*, dragon-flies and ant-lion; 9. *Hymenoptera*, bees and ants; 10. *Lepidoptera*, moths and butterflies; 11. *Rhipiptera*, stylops; 12. *Diptera*, flies.

The *Radiata* form the fourth division of the animal kingdom, and is the lowest in the scale of organization; this order is composed of five classes—1. *Echynodermata*, hard, and spiny skinned, as the star-fish; 2. *Entozoa*, intestinal worms; 3. *Acalepha*, sea-nettles; 4. *Polypi*, plant-like animals, coral and sea anemone; 5. *Infusoria*, water animalcules.

My object has been to give a mere outline of the classification, and I have purposely avoided the minor divisions; the species, genera, sub-genera, and varieties. Nor have I time to touch upon the extinct animals, those remnants of a former age, that inhabited the earth before the existence of man. According to M. Charles Bonaparte,* the number of vertebrate animals observed by naturalists up to the present time (including the fossils), amounts to 18,370. They are as follow: *Mammifera*, living, 1,700—fossil, 520. *Birds*, 7,000. *Reptiles*, living, 1,000—fossil, 200. *Batrachians*, living, 200—fossil, 50. *Fishes*, living, 6,500—fossil, 1,200.

If we examine this chain of organization from the mammal to the mite, what harmony of design, what beauty of contrivance, what adaptation of parts to ends, are unfolded to us. As we descend in the scale of animal creation, we find some of the *radiata* bearing a near resemblance to the vegetable kingdom; some of them like the plants are multiplied by division, and the sense of touch is probably the only one that they possess. Man, the lord of the creation, owes his chief superiority to the formation of the brain and hand; the one directs, the other executes. Compare these skulls of the lion, the ox, and the pig, with

* Bulletin Méd. et Pharm. de Montpellier. February 12, 1851.

that of man. Observe the difference in the shape and size of the brain; look at the beauty of this, the human hand—how admirably is its structure adapted to the performance of its various uses;—how wonderful is the mechanism of the human foot; see the compactness of this arch, combining as it does strength and elasticity in the highest degree, and forming a fulcrum and support to the body, so as to enable it to assume the erect position, peculiar to the human species. Some of you may feel surprise, and perhaps disgust, at being placed in the same order as the monkeys. Walker, the botanist, said "he would rather claim kindred with an oak than with an ape." Lamethrie ridiculed Linnæus for putting man among the mammalia; and Haller, in speaking of the same naturalist, says, "he almost dares to place man and a monkey in the same category." But although man's mental and physical superiority are beyond dispute, the link which separates him from the brute is not so wide as is generally supposed. Place the skeleton of this monkey in the erect position, and take off the tail, and what a resemblance does it bear to the human frame-work, and so with the skeletons of numerous animals, apparently very dissimilar in external form, to the human species. The same type is observable in all the vertebrata—the same outline for the building, but differing in the minor arrangements. Look again at man in his most uncivilized and degraded condition, where the light of Christianity has not shone upon him, and the rays of science have not illumined his path, and what a contrast does he form to some of his more civilized brethren; how nearly does he approach the brute creation.

The three interesting lectures on the North American Indians, which Mr. Catlin has recently delivered in this theatre, have given you a good insight to some of the habits and customs of man in his barbarous or semi-barbarous state. Mr. Catlin is much prejudiced in favor of these people, but I fear he has thought more of their *hospitality* than of their *barbarity*. The men in some respects are worse than the lower animals, for the sole end of their existence appears to be the destruction of their *own species;* the scalping of their enemies often before life has left their bodies, and the ornamenting of their persons with the scalp-locks of the fallen. The men are human butchers—the women slaves. But we find man in a still more degraded condition; not satisfied with killing his fellow-man, he roasts and eats him. You have all heard that there are no people on the face of the earth who do not worship something. I believe this is an error. Mr. Moffatt, the African missionary, informed me that he met with some tribes that had no notion of the existence of a Supreme Being—who neither worshipped stick nor stone; and I believe that some of the natives of Australia are in the same state of darkness. Probably, if we could see the inhabitants of this island as they existed a few hundred years before the landing of Julius Cæsar, the spectacle would not be a very pleasing one—some of our ancestors would not be in full dress. If *we* then have been rescued from a state of barbarity, why may not the intellectual condition of these savages be *improved?* Honor and praise to the good men of all creeds and denominations who are engaged in this holy mission.

I shall now speak of the structure of the lower animals, and its adaptation to their various habits and requirements. The time will only

allow me to give a few illustrations. The monkeys, both as regards form and intelligence, approach the nearest to man: see how greatly this hand of the ourang-outang resembles that of the human species; how intelligent are some of this family: how like is this skull of the togue *(macacus radiatus)* to the cranium of man. The perfection of the hand, and the freedom of motion at the shoulder joint, and their sagacity, justly entitle these animals to the second rank among the vertebrata. Passing over the lemurs, which, like the monkeys, have moveable thumbs that they can flex on the palm, we come to the carnaria, or feeders on animal food: and first of the lion, the king of the forest, as he has been called; and his skull may be taken as the type of the canine and feline races. The teeth, you observe, are formed for tearing and cutting the food, and the canines are of immense size: the space under this, the zygomatic arch, is very great for the powerful muscles that act upon the lower jaw, which has only a perpendicular motion. Compare the teeth of the lion with these of the elephant, a vegetable feeder, and one therefore that requires grinding teeth, and a lateral motion of the jaw. This diagram shows you the construction of the lion's paw, which enables him, and all this tribe of animals, to creep stealthily upon their prey, and then use the concealed claw with fearful effect.

So great is the power of the lion, that he is said to be able to fracture the skull of an ox with one blow of his foot, and then carry him away on his back. This tongue shows the horny papillæ which enable him to scrape the flesh from the bones. If we examine the bears, ant-eaters, and sloths, how admirably is their organization adapted to their modes of life. What a remarkable animal is this, the little ant-eater, *(myrmecophaga didactyla)* with his prehensile tail, he hangs from the branches of trees, and it is almost impossible for an insect to escape his hook-like claw, and vermiform tongue. What a wonderful organ is the trunk of the elephant with its 40,000 muscles; what excellent levers are the tusks. Observe this section of its skull, and you will see that the fore part of the head is composed of bony cells, so that no ball could penetrate the brain-case in this direction; indeed the only place where the small brain can be reached, is above the trunk or through the eye, and then the person who shoots must stand on an elevation. The heart, and other vital parts, are so well protected by the closeness and position of the ribs, that it is almost impossible for a ball to injure them. Chunee, the large elephant at Exeter Change, whose skeleton is at the Museum of the College of Surgeons, had more than 100 shots fired at him. Mr. Cumming, whose remarkable adventures in Africa many of you have read, says, "he wounded one of the largest elephants he had seen, in the shoulder, rendering him stationary." Mr. Cumming, after sipping his coffee, began to make experiments for vulnerable points, the poor animal acknowledging the shots by touching the wounds with his trunk. Mr. Cumming goes on to say—

"I opened fire upon him from the left side, aiming behind the shoulder; but even there it was long before my bullets seemed to take effect. I first fired six shots with the two-grooved, which must have eventually proved mortal, but as yet he evinced no visible distress; after which I fired three shots at the same part with the Dutch six-pounder. Large tears now trickled from his eyes, which he slowly shut and opened, his colossal frame quivered convulsively, and falling on his side he expired."

If Mr. Cumming had possessed a knowledge of anatomy, one shot from a neighbouring tree would probably have saved this noble animal much suffering. and the hunter some condemnation.

There is perhaps nothing more wonderful in the whole range of animal organization than the foot of the horse. See how beautifully these 500 or 600 horny leaves dovetail with the sensible laminæ, and support the weight of the body. Although the foot of the horse in a state of nature is seldom diseased, it is scarcely a matter of surprise that the iron shoe and its daily concussion against stones should produce inflammation and foot-lameness; and one frequent result is the separation of the horny, from the sensible laminæ: thus the coffin-bone falls, the sole becomes flat or convex, and the disease is incurable.

Observe also another admirable contrivance: there is no muscular fibre below the knee, the large muscles above act on these tendons, so that by this means both symmetry and power are gained. How beautiful is the structure of the camel's foot; how well is the elastic cushion fitted for the desert, and how effectually does the formation of the nostrils enable the animal to exclude the burning sand. Again, with what facility does the cloven-foot enable the animals that possess it to get out of the swampy and muddy ground which many of them frequent.

Look at this skeleton of the mole, and what enormous strength is there in the fore quarters to enable it to burrow in the earth. No animal possesses so much power in this respect; the nose too, how well is its form adapted for perforating the soft soil. The long tongues of the giraffes, ant-eaters, chameleons, and woodpeckers, how suitable are they to procure the food which they require. See these nipper-like teeth of the beaver, what carpenter's tool is there that can equal them? How well are these immense mandibles of the Hercules beetle *(scarabæus Hercules)* constructed for dividing the bark of trees. Most quadrupeds are furnished with an elastic, india-rubber-like ligament in the neck *(ligamentum nuchæ)* for the support of the head. This is more developed in the ruminant and pachydermatous animals that so frequently have their heads near the ground. Mr. Queckett tells me that in a giraffe which was dissected at the College of Surgeons, this ligament shrank from 6 feet to 4, when separated from the bones.

There are few structures more interesting than the beaks of birds: observe these diagrams, which are considerably enlarged for the purpose of being seen at a distance.—What a collection of brad-awls, hooks, nippers, hammers, spears, chisels, wedges, saws, razors, pick-axes, filters, suckers, mortars, are here exhibited. See the immense size of the toucan's beak; the pickaxe-like bill of the adjutant; the cutting and tearing bill of the jer-falcon; the strong awl-like bills of the nuthatch and wookpecker. What a curious contrivance is this, the beak of the crossbill, to enable the birds to pick out the seeds of the pine-cone, upon which they feed; these mandibles act as chisels, wedges, and forceps.

Observe the large mouth of the goatsucker, furnished with lateral hairs to prevent the escape of insects which it takes on the wing. The bill of the duck, with its serrated edges, when closed, forms a filter, allowing the escape of the water, and retaining the more solid materials. How well is this, the bill of the merganser, constructed for holding its slippery prey, resembling somewhat the mouth of this curious fish

(belone Guianensis.) The avosett's beak, you see, is curved, and adapted for sweeping the surface of the mud; indeed, the form of the beak generally tells the habits of the bird, as the teeth do those of the carnaria. Again, look at the construction of the feet; how beautifully is this, the foot of the grebe, formed for propelling the bird through the water; this foot of the sparrow-hawk, with its long sharp talons, what a formidable weapon of attack is it; these feet, of the climbers, scratchers, runners, waders, perchers, how perfectly are they contrived to answer their respective uses.

The colour of animals always answers some wise purpose. The ebony skin of the African is well adapted to protect him from the effects of a tropical sun. I met with a good illustration of this a short time since: I was walking in the fields with a farmer in Essex, and I observed to him that all his pigs were black; he told me that he preferred this colour, as "they did better in the fields, the skin of the white pigs being liable to crack in hot weather." On enquiry, I find the correctness of this opinion confirmed by others. Concealment appears to be another object; the animal often being screened from its enemies by its colour corresponding with the surrounding surface; thus in the north of Europe, where the ground is so often covered with snow, many animals are white, which here are dark: the grouse, partridge, hare and fox, may be mentioned as examples; the ermine, in this country, which is a reddish brown in summer, becomes white in winter, as does also the male of the snow-bunting. The young of these birds, the gulls (which are white) are of a lightish ash colour, dotted with black, so that it is almost impossible to distinguish them from the shingle in which they sit. Again, the eggs of all ground birds are of a dark colour, whilst many of those whose nests are more elevated, are white. The only ground birds' eggs which approach the nearest to this colour (that I know of) are the eggs of the duck, pheasant, and partridge; but the duck and the English partridge cover their eggs so that they cannot be seen. The pheasant does so occasionally, and the French partridge (the eggs of which are much darker) never, or very rarely. It is probable that the colour of the eggs of the common hen has been changed by domestication. How admirably also the colour serves to enable some animals to take their prey: how like is the lion's skin to the sandy desert—the stripes of the tiger to the long grass in which he is concealed—the spots of the leopard and tiger cat to the trees they frequent—the lizard to the green foliage, or sandy bank. This alligator, how perfect is the resemblance of his hide to the slimy mud. How great, often, is the correspondence between the colour of another class of reptiles, the ophidians, and the ground on which they move. A friend of mine saw this serpent (*trigonocephalus*) in Trinidad, lying across his path, and as you may readily suppose, from its colour, took it for the dead branch of a tree, until its motion arrested his footsteps. Its poison is most deadly.

The coverings of animals again, are wonderfully adapted to the climates and elements which they inhabit: thus we have a warm thick fur in the northern regions; a thin hairy coat in the tropics—in the air the light and beautiful feather—in the water the crust or scale. What armourer could make a coat of mail to equal that in which this

armadillo* is enveloped? how well it protects him from the weapons of his assailants, and from the falling trees and branches in his path.

Many of the inferior animals not only possess the five senses, but some of them are more perfect than in man; more especially the sense of smell: the dog can scent his master in a crowd of a thousand persons. These long-snouted animals, the pig, ant-eater, mole, coati-mondi, badger, as well as the long-billed birds, have both the senses of smell, and touch to a high degree, to enable them to obtain their food in the the dry or wet earth. But the sense of smell is probably more exquisite in birds than in other animals. I have several times visited a decoy for taking wild fowl, and those who enter are compelled to carry burning turf near their mouths, in order that the birds may not detect their approach, and take flight. I once, after a day's hare-shooting, took some retrievers to look for the wounded game that had escaped, and afterwards died. The carrion-crows, however, that had found the dead hares, were the best guides: these birds had not been observed in the neighbourhood for some time before. It has long been a disputed point, as to whether the carrion birds find their food by scent or by sight; but I think Waterton's experiment is conclusive: he placed the carcass of a pig (in the night) in a ditch, and so covered it with bushes, that it could not be seen; early in the morning, there were plenty of vultures near the spot, although before this, they were not visible. Waterton afterwards stuffed the dried skin of a deer, and exposed it in the middle of a field, but not a vulture came near it.

The eye varies much in size and form in different animals. In the elephant, bear, mole, armadillo, and some of the underground animals it is small; in the owl, eagle, nightingale, antelope, hare, lynx, gazelle, and those that require a great extent of vision, it is large. The pupil also varies in shape; in man, the monkey, birds, and many fishes it is round; in horses, cows, and sheep, oblong. In the skate and cuttle-fish, crescentic. The eye of the camel is beautifully protected from the sand of the desert, by its large lid and long lashes. The prominence of the eye of the defenceless hare, enables it to see backwards, but I know of nothing more astonishing than the eyes of the chameleon, they are enclosed in projecting globes, which move in all directions, so that one eye may be directed forwards, and the other backwards; a provision that enables a tardigrade animal like this, to see every insect that comes near it, and then to pounce upon it with its long and glutinous tongue, The quick sight of the nightingale makes him a ready prey to the bird-catcher, who easily takes him with a spring trap, baited with a meal-worm. How admirably is the large pupil of this, the barn owl *(strix flammea,)* fitted for collecting the rays of light, whilst his noiseless flight, enables him to steal upon the small night-feeding animals, which he captures with his powerful talons. In insects the eyes are fixed, but to compensate for this, some of them have a multiplying power, in a number of lenses, as in the scorpion, fly, and dragon fly; the eye of the last is said by Leeuwenhoeck to contain 12,000 separate lenses. Most fish have this sense in great perfection, as all

* In the fossil Armadillo *(glyptodon clavipes)* which may be seen at the Hunterian Museum, and which measures probably 3½ yards in circumference—the pentagonal divisions are fixed.

fishermen know. I believe one great secret in rod-fishing (especially for trout) is to keep as much as possible out of sight.

In some animals the sense of hearing is very acute; others are without this sense; the barn-owl, of which I have just spoken, has by means of a cutaneous muscle, the power of opening these feathers over the external ear, so that in the stillness of the night, no sound escapes him. These drawings shew you the ears of various animals, and also the position the external ear can assume under different circumstances, by the movement of certain voluntary muscles. All who have sat behind a blind horse, must have observed that the concave part of the ears is directed forwards to catch the sound. Observe these ears of the stag, hare, bat, lynx, llama, horse, and elephant: the construction of all of them is nicely adapted for the collection of sound. In addition to this sound-collector, there is an internal membrane, the tympanum or drum, which by means of certain muscles is rendered lax or tight, according to the lowness or intensity of the vibration. In the ostrich, a bird that lives in the desert, and is likely to be surprised by numerous enemies, the external ear is large and auricular. In fish, the sense of hearing is much less perfect than that of sight. In the crustacea the ear consists only of a simple sack, and it is questionable whether insects possess any auditory apparatus.

Nature has provided most animals with some means by which they may escape their enemies, either by stratagem, swiftness, or by defensive weapons. The teeth, tusks, swords, stings, beaks, talons, coats of mail, spines, all admirably effect these intended purposes. Some animals emit a fœtid odour so as to disgust their enemies: I once shot at a stoat, and probably wounded it; I could scarcely bear the place, so offensive was the smell. The cuttle fish has the power of throwing out a dark fluid, so as to render the water black and opaque, to its enemies. What an extraordinary weapon is the lance of the sword-fish, (*xiphias clodius)* one of these has perforated the bottom of a South American whaler, to the depth of $13\frac{1}{2}$ inches: this may be seen in the Hunterian Museum. The galvanic batteries of the torpedo, *(galvanis torpedo)* and of the electric eel, *(gymnotus electricus)* how wonderful is their construction—how powerful their effect. The wild horse has been so paralyzed by the shock of the former, as to render him an easy capture. The kangaroo, an animal that stands erect by forming a tripod with its tail and hind legs, although apparently without any means of defence, will when attacked by a dog, hug him with his fore paws, and sometimes tear out his bowels with his powerful hind feet. I have known the coat of a man nearly torn from his back by this animal, in the manner described. The wild dog of Australia will often feign death, and on the departure of its enemy, slink off.

The weapons I have just alluded to, serve as means of offence, as well as defence, and are used by animals in capturing their prey; but it is wisely ordered that they generally destroy their victims very quickly, so that they endure the least possible suffering. This is well seen in the manner in which the weasels and all this class of animals seize their prey. The domestic cat plays with the mouse, but the wild cat kills it instantly, and it is curious that domesticated animals as the rabbit, appear to lose the natural dread of their enemies. I have seen

a tame rabbit look at a boa-constrictor when his head was elevated for the deadly thrust, with the greatest apparent indifference; but the young of the wild rabbit, at the sight of a weasel, are scarcely able to move, and a mouse, when pursued by a snake, has appeared to be transfixed to the spot.

The voracity of some animals is extraordinary, and when suffering from hunger their boldness is very great. I once caught a pike with a leaden plummet when sounding the depth of a river; but one of the most extraordinary instances of voracity I have met with, was witnessed by Mr. Edwards, of Wood Hill, Sutton, Suffolk. A large hook, baited with a roach, was swallowed by a pike which weighed $3\frac{1}{2}$ lbs.; this was swallowed by a second pike, which weighed $22\frac{1}{4}$ lbs., and both were taken. In another instance a pike had swallowed two roach with hooks in them. So great is the voracity of the cormorant, that he has been used to catch fish with a ring round the neck, so as to prevent his swallowing them. A curious instance has lately come to my knowledge of a weasel that was killed with a duck's egg over his head: like some bipeds he fell a victim to the last drop. This act, by the bye, does not accord with the vulgar adage, which I need not repeat. The shrikes or butcher-birds, hang up their prey. They generally impale the insects or small birds on a thorn. I have recently met with a singular instance of this,—Mr. Kidman, of Kelsale, Suffolk, had ten or twelve young partridges; these were all killed by the red backed shrike, (*lanius collurio*,) and hung up on a thorn fence near the coop. Some carpenters, who were at work close to the place, saw them in the act. Mr. Kidman shot seven of the shrikes near the spot. When the relative size of the two birds is considered, the circumstance is very extraordinary. I have seen the common rook hunt a pea-field where pheasant eggs were very abundant, and if a pheasant happened to be off her nest, an egg was at once pounced upon. But what can equal the beauty of the spider's web, and the ingenuity displayed in the construction of the net? What a wonderful little animal is this, the ant-lion, *(formica leo,)* this drawing shows his pit-fall. If the insect should escape his nipper-like jaws, he brings it into his den with the shower of sand he throws upon it.

What a wise provision of nature is it that allows one animal to prey upon another, so that a proper equality is maintained. If it were not for this law, locusts, gnats, flies, ants, aphides, worms, grubs, caterpillars, fish, rats, mice, deer, rabbits, hares, &c., would so increase as to fill both land and sea. This carp which I caught in Essex, weighed 4 lbs.; it contained two and a-half millions of ova. I counted the number in one grain, (their size being equal,) and then, by weighing the bulk, I easily obtained the amount. Some years since I formed one of a party of sixteen to shoot hares; nets were placed to prevent their going beyond a certain line, and in six days we killed 2,560. I mention this, because the natural enemies of these animals, such as stoats, weasels, polecats, hawks, and ravens, were destroyed by the gamekeepers, and hence this enormous increase. A gentleman from Norfolk stated, before a committee of the House of Commons, that he had kept hares for the purpose of ascertaining the quantity of food they consumed, and I think he found that three of them ate and *spoiled*, as much as one sheep. But there is probably nothing created that

does not serve some useful purpose when left in a state of nature; and animals that are often thought to be injurious, are very beneficial; as the mole, rook, and insect feeding-birds: the first destroys the wire-worm, and other insects that are hurtful to vegetation. A colony of rooks will consume hundreds of bushels of grubs in a season. Kirby mentions a farmer who had his meadow covered with rooks, which he supposed were destroying the roots of the grass, as the ground was perforated in all directions. But these birds were feeding upon the grub of the cock-chafer, *(melolontha vulgaris,)* a destructive insect that remains in the larva state for four years. The number of caterpillars that the young of some small birds are supplied with is almost incredible.

I now come to the most interesting part of the subject, viz., a comparison of the intelligence of man, with that of the lower animals. Some are inclined to doubt the existence of reason in the brute, and I confess the subject is a difficult one to grapple with; and I have only time for a cursory glance. The habits and intelligence of the bee and the ant, would form an ample theme for a dozen lectures, and yet these animals are low in the scale of organization, and their brains are so small, that they are scarcely perceptible. Some of the vertebrata possess the power of imitation to a high degree, and they exhibit a certain amount of reason; but they generally act from an instinctive feeling—a blind impulse. The nest of one species of bird bears the same form and construction; the duckling reared by a hen, runs to the water. The young of the wild-duck, although hatched and reared by a domesticated one, do not lose their natural shyness. The bird does not know her own eggs; pieces of chalk may be substituted for the eggs, and the old bird will continue to sit upon them. The hedge-sparrow, wagtail, and robin, will hatch and rear the young of the cuckoo; and some of the mammalia are equally accommodating. I have known a litter of young foxes suckled by a cat; but the skin of the dead lamb is often put upon the strange lamb, before the ewe will allow it to take its food. Birds often return to the same spot year after year to make their nests, although their offspring have been captured. A proof that they have no forethought. When a boy, I have taken the young of the barn-owl, magpie, and hawk, and the old birds came again to the same tree. The swallow annually travels hundreds of miles through the trackless air to the same house, even if its nest has been demolished. A lady of my acquaintance, residing in Suffolk, had her bed room window left open accidentally, and two swallows built their nest in the folds of the bed curtains where they reared their young for two successive years; they commenced building the third year, but the lady shut them out, the number of visitors making her sleeping apartment rather too public.

The instances of the sagacity of the dog would fill volumes. A brother of mine (Mr. R. Crisp, of Leiston, Suffolk) has a large spaniel, which he uses as a retriever; the dog is quite deaf, but he frequently looks back to be directed by the hand of his master. This dog, when *tired*, and a partridge is only winged, lays it upon the ground, puts his paw upon it, and sticks two of his teeth through its brain. This is to prevent his eyes being hurt by the pinions of the bird when it flutters, it also being much easier to carry when dead. I have known an old

pointer go round French partridges (which generally run to the end of the field) so as to get them between himself and his master. I have frequently watched a terrier and a large water-spaniel hunt hares in concert; the business of the terrier was to hunt the long grass in the marshes, whilst the spaniel stationed himself at the only place where the hare could make its escape, and he remained still until it came near to him. I could record instances innumerable of the sagacity of the bee, ant, monkey, elephant, fox, parrot, magpie, and raven. Many of the anecdotes of the last bird are curious. My brother (before-mentioned) had a raven that almost equalled in sagacity and intelligence the famous Grip, described by Dickens in Barnaby Rudge. This bird belonged to a clever family that had been obtained from the same tree for several years. When young he showed great precocity, and exceeded all his brothers and sisters in the faculty of imitation, and in general acquirements. Grip would follow his master when on horseback for miles; sometimes flying; sometimes sitting upon his owner's shoulder, or upon the horse's back. He would follow him to church, and meet him on his return; but never went very near the building. He would sit on my brother's shoulder when he fired at a bird, which he flew after when it fell, and always appropriated it to his own use when allowed to do so. Grip was a mortal enemy to dogs, cats, and poultry. He would pull a hen off her nest, suck her egg, and then mimic her cackle to perfection. He would carry kittens to the top of a high wall; take hold of the tip of their tails with his beak, dangle them in the air, and as they fell imitate their mewing. He was a mortal enemy to dogs; he would pull their tails, fly off, and re-echo their bark. Occasionally, like other bipeds, he would indulge too freely in the juice of the grape, and lose his equilibrium. It would take a long time to describe the mischievous propensities and antics of this bird. His fondness for field sports cost him his life—his end was a melancholy one. Two gentlemen were partridge shooting, and Grip, when he saw a partridge fall, flew after it, and was shot by one of the party, who thought it was a wild bird. The sagacity and cunning of the fox are proverbial. Mr. St. John, in his "Tour in Scotland," mentions a curious example of it. "A fox saw some ducks on a lake. He went to windward of them; then he took some pieces of grass and rushes, and floated these towards the ducks. He next took a large piece of grass in his mouth, swam down the stream, and captured the largest mallard!" A servant, in the employ of my friend, Mr. Constable, of Wix, Essex, saw a fox rolling about on a ploughed field. A magpie soon made his appearance. The fox instantly stretched himself out as if dead; and, when the magpie approached near enough, he made a spring and carried it off. Mr. Frost, of Thorington Hall, Essex (an old fox-hunter), tells me that "last year one of his ducks hatched her eggs near a litter of cubs (fox), and she was not molested; but Mr. Frost believes that if the duck had been found at a greater distance from the house, she would have been killed."

The love of the lower animals for their young is most intense, but it is happily arranged that this affection ceases when they are able to take care of themselves. The attachment of the bear, lion, and most of the carnivora is well known, and many of them will sacrifice their own lives in the protection of their offspring. But it is perhaps more

astonishing in the defenceless bird. The plover, curlew, wood-pigeon, partridge, and other birds, sham lameness to lure their enemies from their nests. I once in Scotland frightened a curlew (one of our wildest birds) from her young, and so close did she keep to me that I could almost reach her with my fishing-rod. The old partridge will lead a dog away from her young ones, by fluttering before his nose (taking good care to keep out of his mouth,) across two or three fields, or half a mile up a road; then, when she fancies all is safe, she quietly rises over his head and returns to her brood. Many of the small birds will almost allow themselves to be taken on their nests rather than discover them by their flight, and some birds during incubation exhibit extraordinary courage. The missel-thrush, goose and hen, are familiar examples. Many birds will feed their young if they are taken from the nest and placed in a cage, and sometimes they will follow the nest for a great distance. My friend Mr. R. Edwards tells me, when he was at Swan River, "a pair of swallows built their nest under the thwart of a boat which was sometimes twenty miles up the river, and in a day or two down again, but the birds always accompanied it." Birds, too, are especially careful to place their nests in such positions as to evade discovery. The color of surrounding objects, also, is generally imitated, and they remove the dirt from under the nest. A swallow, year after year, built its nest in a corner of the back kitchen at Shottisham Hall, Suffolk; if shut out by the closing of the door, it would come in down the chimney. It was frequently observed that the swallows carried out something, which on one occasion was dropped, and found to be dried dirt from the nest.

Even some insects show great affection for their young, especially the ant, and spider. The viper opens her mouth when her young ones are in danger, and allows them to scriggle down her throat; this is disputed by many, but I think I possess evidence that puts the matter beyond a doubt.

How unaccountable is that extraordinary power which enables some animals at certain seasons to change their localities, and travel thousands of miles, for change of food or temperature. So strong is this impulse, that I have known a nightingale almost destroy itself by knocking its head against the wires of its cage, at the migratory period. This bird, the land-rail, *(rallus crex,)* although a bird of short and slow flight on land, is able to cross the sea, and it is possible, though not probable I think, (as some have suggested of the quail,) that it takes advantage of the wind, and uses one wing as a sail, and the other as an oar, to flap the air. In some countries these migrations of animals occasion much damage. The swarms of antelopes, ants and locusts, will destroy all before them, but we are especially indebted to this law, for the enormous supply of fish in our markets. The herring, sprat, salmon, cod, haddock, mackerel, sturgeon, pilchard, anchovy, are all migratory fish, and are caught only at certain seasons. How incomprehensible is the faculty that some winged animals possess of going at once through the pathless air to their destination. The American honey collectors are said to find the honey of the wild bee by catching one of the insects and by observing its flight. Bruce, when searching for the Nile, saw a widgeon in a pool of water; his attendants were going to shoot the bird, but he with his usual quickness of per-

ception, was enabled by its flight to calculate the distance and direction of the river.

Many animals possess the faculty of constructiveness to a surprising extent; but birds, beavers, moles, bees, wasps, spiders, and caterpillars, have it in great perfection. How curious are the nests of the weaver, tailor, and reed-birds. See this beautifully constructed, oblong nest, of the long-tailed titmouse *(parus caudatus,)* with its almost imperceptible doorway; it contained eighteen of these small white eggs, and the number sometimes amounts to twenty-four, so that the young birds are rather closely packed, and the old ones can have no easy task to supply them with food. In this nest also of the harvest mouse, what delicacy of structure is displayed; all the artizans in the world could not make one like it! There is, you see, a small entrance in front, and the grass is left so thin at the back part, that the mouse could easily escape in the rear, if necessary. The nest of the magpie is covered over with sharp thorns, so as to form a kind of basket for the protection of the young. Jesse, in his *Recollections* of *Natural History*, mentions a jackdaw's nest built in the bell-tower of Eton Chapel College in seventeen days, which measured ten feet in height, and was formed of a solid stack-work of sticks. The base being on one of the steps, and the summit on a level with the window, so that the old bird could easily effect her escape; but one of the most curious instances of constructiveness is in the wattled talegalla, *(talegalla Lathami,)* a gallinaceous bird described by Mr. Gould in his splendid work on the birds of Australia, (vol. v.) These birds work together and collect with their feet from two to four cart-loads of decaying vegetable matter. When a sufficient amount of heat is engendered, the eggs are deposited, the hen birds watching for the young at the period of hatching. These heaps are considered great prizes by the natives, who sometimes obtain more than a bushel of eggs from one of them. The same author, (vol. iv.) gives an interesting account of the bower-birds; one of their bowers he brought to England, and it may now be seen with two others in the British Museum. At the Regent's Park Zoological Gardens there were three of these birds *(chlamydera maculata)* last year, but two of them have died. Their bower may still be seen. These bowers, playing-grounds, or halls of assembly, as Mr. Gould calls them, are generally composed of flexible twigs upon a basement of coarser sticks, the tops of the twigs curving inwards, but leaving the interior of the hall smooth. The entrance is decorated with shells, feathers, and any gay material the birds can find. The structure appears to be made merely as a playing-ground, and not for the purpose of incubation. Of the three species described by Mr. Gould, the satin bower bird *(ptiloronynchus holosericeus)* appears to have the greatest propensity for decoration. Other animals hatch their eggs in the sand; as the ostrich and alligator. I have known the eggs of the wild duck hatched in a cucumber bed, and the young afterwards reared, a fox having killed the old bird. Animals when influenced by the instinctive impulse for the propagation of their species, sometimes have recourse to strange contrivances. Some years since I attended professionally a man who bred canaries. I had noticed a young bird just fledged, (the only one,) and to my great surprise one day I saw it denuded of its feathers. The man had omitted to put moss and wool into the cage, and the old

birds had stripped their offspring for the purpose of making another nest. I have known the common rat, in London, divide a shirt hanging by the fire, with its scissors-like teeth, and carry a part of it away for the construction of its nest.

There is no doubt that all animals make themselves understood by their own species; how great the hubbub, and what a variety of notes among the small birds, when an owl, or a hawk makes its appearance! The call of the partridge, the cackling of the hen, the cooing of the pigeon, the crowing of the cock, the imitative note of the mocking-bird, the hiss of the serpent, and the roar of the lion, are all indicative of feeling, and passion. Bird-catchers turn this knowledge of language to good account, by mimicking the voices of various birds. In Sweden, the young of the capercailzie *(tetras urogallus)* are easily taken by imitating the call of the parents.

The character of the voice in birds generally depends upon the structure of the lower part of the windpipe *(trachea)*; and the modulations of sound are little influenced, as in man, by the muscles at the entrance of the tube. You have all observed the difference between the voice of the duck and the drake: the lower part of the windpipe of the latter is furnished with this curious appendage, which tends to increase the sound. Observe this enormous dilatation at the inferior end of the trachea of the merganser; what an excellent receptacle is it for the air which the bird requires when under water. The elastic rings will also account for the softness of its voice.

Insects are not furnished with a trachea. The buzzing of the bee, fly, and other insects, is produced by the wings. The chirping of the grasshopper and cricket is occasioned by the action of the thighs, upon the elytra or wing-covers. This little beetle—the death-watch—(*anobium pertinax*) the round holes formed by which you have seen in old timber, makes its peculiar tick by knocking its jaws against the wood, a sort of love-call or serenade to its mate. I have received the following interesting communication from the Rev. Mr. Whalley, of Great Wenham, Suffolk, respecting the habits of these insects. He says, "At a certain season of the year (about May or June, if I recollect rightly), I often see these insects on the wall, bending their heads forward, as a man would who should try to make his chin touch his breast; and beating by the violent action of the whole body the crown of the head against the wall, thus making a very audible tapping. This signal is not only given in answer to the tapping of other insects, but if I, with the tip of my finger-nail, make a similar tapping, the insect will reply to me without the slightest hesitation, as often as I please. Six or seven little taps, with the tip of my nail, almost to a certainty will induce the insect to bang his head as many times against the wall!"

The lower animals, like man, find great benefit in organized societies; and the ants even have their slaves, which they take from neighbouring colonies when young, and make them labor for the general good of the community. But they have neither whips nor chains, like those of our Transatlantic brethren. In the gregarious animals there are outposts and sentinels, to tell of approaching danger; and all, like true patriots, fight for the common weal. Whether their government is monarchical or republican, or whether they have any hereditary aristocracy, I am unable to say; but they have an able president, who takes the lead.

By union, some animals are able to defy even the lion, who would easily destroy them single-handed.

Amongst the foremost of the advantages of the study of natural history is the expansion of the mind, and the removal of superstition. If this science were more cultivated, the follies, quackeries, and juggleries of the day, would be less rife. Another of the innumerable benefits of this pursuit is the aviodance of many errors which those ignorant of zoology are apt to fall into. One of our poets speaks of the enjoyment of the oxen when frisking about in the noon-day sun; but the antics of these animals are anything but pleasurable, as they are caused by the sting of the gad-fly (*œstrus bovis*). Another writer describes "the rooks flying away from the roof of an old chateau as the carriage approached the building." But these supposed rooks must have been jackdaws. Mr. Moffat, in his "Southern Africa," says, "the Bushmen will poison small fountains, when the water is nearly stagnant, with the venom of the serpent, to cut off their pursuers." But the venom of the serpent may be *swallowed* with impunity. The common moth (*tinea destructor*) has the credit of being a great destructive; but it is perfectly harmless in its winged state. The maggot is the destroyer; and the only use of the pepper and spices that are applied to the cloth, is to prevent the moth from depositing her eggs upon it. The hedgehog is said to suck the cow, although its mouth is too small for the teat. The little shrew-mouse is supposed, in some places, to lame the cattle it runs over; the tick of the death-watch, and the croak of the raven, are thought by many to forebode death; and I could enumerate many other examples of ignorance and superstition. Even our immortal bard, Shakespeare, has fallen into a great error in his oft-quoted lines of the "*poor beetle.*" But it is wisely ordered that the lower we descend in the scale of organization, the less is the nervous development and sensibility of the animal.

I now bring this hasty sketch to a termination. Some, perhaps, may think it too egotistical; but my desire has been to place before you facts that have come within my own knowledge. I have been obliged to hurry over many subjects that required better elucidation; but I trust, without pretending to any great depth of zoological research, I have said enough to interest some of my hearers. To the young, I especially recommend the study of natural history; nature's page is ever open to them; her beauties are inexhaustible; many of her treasures have yet to be explored, and her secrets unravelled. On the score of health, too, what advantages does this study afford to the man pent up in city walls, and breathing the tainted atmosphere of a large town. How beneficial is it to inhale the pure air of the country, and at the same time have the mind diverted from its customary pursuits.

How preferable is it to study *things*, rather than *words*; to know the wonders of God's works. And whether we look to the valley or the mountain, the swelling sea, the foaming torrent, the smooth-flowing river, the stagnant lake, or the arid plain, we may exclaim with the poet—

"Not a tree,
A plant, a leaf, a blossom, but contains
A folio volume.—We may read, and read,
And read again; and still find something new;
Something to please, and something to instruct,
Even in the humble weed."

21, *Parliament-street*,
March, 26*th*, 1851.