

ZOOLOGY

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IN THE

NATURAL SCIENCES.



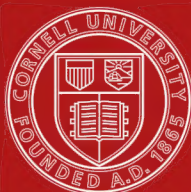
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FOURTEEN WEEKS IN ZOOLOGY.



THE FIVE CLASSES OF VERTEBRATES

A. S. BARNES & CO.
NEW YORK PUBLISHERS. CHICAGO.

FOURTEEN WEEKS

IN

ZOOLOGY.

BY

J. DORMAN STEELE, PH. D., F. G. S.,

AUTHOR OF THE FOURTEEN-WEEKS SERIES IN NATURAL SCIENCE

*"And Nature, the old nurse, took
The child upon her knee,
Saying, 'Here is a story-book
Thy Father hath written for thee.'"*
Longfellow's "Tribute to Agassiz.

A. S. BARNES & COMPANY,
NEW YORK, CHICAGO, AND NEW ORLEANS.

B

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P R E F A C E .

THIS work is prepared upon the same general plan as the preceding books of the Series. Among the principal features are: Brevity; directness of statement; such a presentation of the subject as will lead the pupil to love the study; frequent foot-notes, containing anecdotes, curious facts, explanations, etc.; a uniform system of analysis in bold paragraph titles; and a gradual introduction of scientific terms and language, so as to fit the scholar to read zoological literature.

Believing that a description of a new animal without a cut is useless, the author has aimed to give a figure of each one mentioned; accompanying it, where necessary, with minor illustrations of functional peculiarities. In order not to discourage the beginner with dry and dull anatomical details, the text is largely occupied with biography, telling "how animals act, think, and are mutually related;" for a fact concerning the adaptation, habits, etc., is as valuable and far more interesting to the young, than one about some unpronounceable bone or muscle.

To lead, however, to closer observation, physiological distinctions are grouped in frequent paragraphs under the head of General Characteristics, a section is given on Comparative Anatomy, and numerous cuts of skeletons will enable any teacher familiar with the subject to continue it as desired.

The limits of the book compelled a selection to be made from the numberless animal forms. Every order, however, is named, with most of its families and many of the principal genera, each one illustrated by a cut and description of a

typical species. Tables for classification precede, in general, every division. These will enable the pupil to refer any animal to its order, and, in many instances, to its family and genus; though it should be borne in mind that the characteristics given are applicable to the genera and species described in the text, and not necessarily to all belonging to the family. In addition to these analyses, a tabular view of all the animals treated is inserted in the Appendix.

It has not seemed best to define each term in the text, but the Index is very full, and contains the explanation, definition, and reference of every ordinary zoological word. As far as possible, each scientific name is followed, in parenthesis, by its translation. To guide in pronouncing the titles of the cut, the quantity of the penult is carefully given.

Ample directions to the beginner for collecting and preserving specimens are given at the close of each division. These, with the hints in the foot-notes, will enable the pupil to undertake the study of Nature understandingly.

The author would hereby acknowledge the vital assistance rendered in the preparation of this work by J. W. P. Jenks, A. M., Professor of Agricultural Zoology and Curator of the Museum, Brown University. His life-long experience and remarkable success in teaching Zoology, together with the wide range of his observations, have alone rendered this book possible. Thanks are returned to J. W. Armstrong, D. D., President Normal School, Fredonia, N. Y.; F. C. Clark, M. D., Providence, R. I.; Charles W. Greene, A. M.; Prof. D. S. Kellicott, Ph. M., Buffalo State Normal School; and S. G. Love, A. M., Supt. Schools, Jamestown, N. Y., who have read the proofs, and furnished many excellent suggestions.

Many of the cuts were taken from nature; the others were selected from the works of Owen, Carpenter, Wood, Milne-Edwards, Jones, Woodward, the Pictorial Museum, etc. A number of our wood-cut illustrations are from Prof. Sanborn Tenney's Natural History Series.

SUGGESTIONS TO TEACHERS.

THE Tables are not, at first, to be committed to memory, but only read to give a general view of the subject, and afterward learned by a constant reference to them as each class, family, etc., is taken up in order. Thus, the large table on page 13 should be in constant use during the term, and the last part would not be fully understood until the book is finished. The text contains nothing which the cut can better exhibit; hence the figure should be studied carefully. The teacher is advised to require his pupils to draw on the board an outline of each animal, showing its size as obtained from the scale under the cut, and every peculiarity in the structure of its teeth, claws, hoofs, bill, etc. This should be followed by a familiar description, drawn from the cut, the text, the teacher's instructions, and every other source of information—above all, the creature itself, where it can be secured. (See note, p. 114.)

Pupils should be encouraged to make original researches. They can prepare (see page 14) the skeleton of a cat, dog, or other small animal. They can secure common birds, squirrels, frogs, snakes, and insects; and a little practice will often develop a taste for curing and mounting which will be as instructive as delightful. They can make collections of birds' eggs and nests. Even the careful study of a common fowl or an oyster, a bird building its nest, an ox chewing its

cul, a spider spinning its web, a cat catching a mouse, the varied paces of a horse, or the metamorphosis of a caterpillar, will give a fresh zest to the work. If any opportunity offers, the class should visit a menagerie, book in hand, name the animals, and verify the statements of the text.

The knowledge of the teacher should be sufficient to fill out and supplement the brief descriptions of a text-book. The following works will furnish additional facts, and aid in further investigations. Pupils may often be persuaded to procure copies as a foundation for their library: Packard's "Guide to the Study of the Insects;" Dana's "Corals and Coral Islands;" Wood's "Natural History," and "Homes without Hands;" Coues's "Key to North American Birds;" Baird, Brewer, and Ridgway's "North American Birds;" Agassiz' "Sea-side Studies;" St. George Mivart's "The Common Frog;" Allen's "Mammalia of Massachusetts;" Samuels' "Birds of New England;" Carpenter's "Comparative Physiology;" Figuier's popular works on Natural History; Jordan's "Vertebrates of North America;" Orton's "Comparative Zoology," etc. The back volumes of the "American Naturalist," "Popular Science Monthly," and "Harper's Magazine" (see Natural History in the Index volume), contain numerous excellent articles, many of them finely illustrated. The above-named books, as well as a microscope, so essential to efficient instruction, can be obtained of the publishers of this work, Messrs. A. S. Barnes & Co., 111 and 113 William St., New York. Specimens of all the typical species of animals, as well as many beautiful casts, are constantly kept for sale by Prof. Henry A. Ward, Rochester, N. Y.

TABLE OF CONTENTS.

I. INTRODUCTION.....	PAGE 11
HINTS FOR PREPARING SKELETONS.....	14

II. THE VERTEBRATES.

1. SUBKINGDOM VERTEBRATES.....	15
THE MAMMALS	16
THE BIRDS	110
MIGRATIONS OF BIRDS.....	162
HINTS FOR PRESERVING SKINS OF MAMMALS AND BIRDS.....	163
THE REPTILES.....	165
THE AMPHIBIANS	179
THE FISHES.....	184
HOMOLOGIES AND ANALOGIES OF THE VERTEBRATES.....	199
HINTS FOR STUDYING REPTILES, AMPHIBIANS AND FISHES.....	202

III. THE INVERTEBRATES.

2. SUBKINGDOM ARTICULATES ..	203
THE INSECTS.....	204
HINTS FOR COLLECTING INSECTS.....	224
THE MYRIAPODS	225
THE SPIDERS	226
THE CRUSTACEANS	229
THE WORMS.....	235

	PAGE
3. SUBKINGDOM MOLLUSCANS.....	241
THE CEPHALOPODS.....	242
THE GASTEROPODS.....	244
THE LAMELLIBRANCHIATES.....	250
THE BRACHIOPODS.....	255
THE TUNICATES.....	255
THE POLYZOANS.....	257
4. SUBKINGDOM ECHINODERMS.....	259
THE HOLOTHUROIDS.....	259
THE ECHINOIDS.....	260
THE ASTEROIDS.....	261
THE CRINOIDS.....	263
5. SUBKINGDOM CŒLENTERATES.....	265
THE CTENOPHORANS.....	265
THE ANTHOZOANS.....	265
THE HYDROZOANS.....	269
THE SPONGES.....	273
6. SUBKINGDOM PROTOZOANS.....	274
THE INFUSORIANS.....	274
THE RHIZOPODS.....	275
THE GREGARINIDANS.....	277

IV. APPENDIX.

TABLE OF THE ANIMAL KINGDOM.....	278
INDEX AND GLOSSARY.....	298

INTRODUCTION.

ZOÖLOGY (*zoon*, animal; *logos*, a discourse) treats of animals. It includes every variety, from man to the tiniest microscopic creature. Recent investigations in Comparative Anatomy seem to indicate that all the varied forms of life so shade into one another as to furnish no sharply-marked dividing lines: and that could the animals which have become extinct be grouped with those now living, the entire series from man to the animalcule would present an unbroken succession. This panoramic view would give an idea of unity in the same sense as when we speak of a herd of cattle, though the individuals differ in size, color, and form; or of a landscape, in which there is no break in the undulating outline of the far-off horizon, though it include river, mountain, and valley.

Classification.—In order to understand Zoology clearly, it is necessary to separate this vast **ANIMAL KINGDOM**, as it is called, into different groups. If we examine the general structure of the various animals, and bring together those which have similar peculiarities—as, for instance, a back-bone—we shall form the first grand divisions, which are styled *SUBKINGDOMS*. There are only six of these typical ideas; each, however, developed by the all-wise Creator in wonderful diversity.

Observing the characteristics of the animals composing a subkingdom, particularly with regard to their physiological distinctions—as, for instance, whether they are covered with hair or feathers—we reach the divisions of each subkingdom, which we designate as *CLASSES*.

Observing the characteristics of the individuals of each Class with regard to their adaptation to their mode of life—as, for

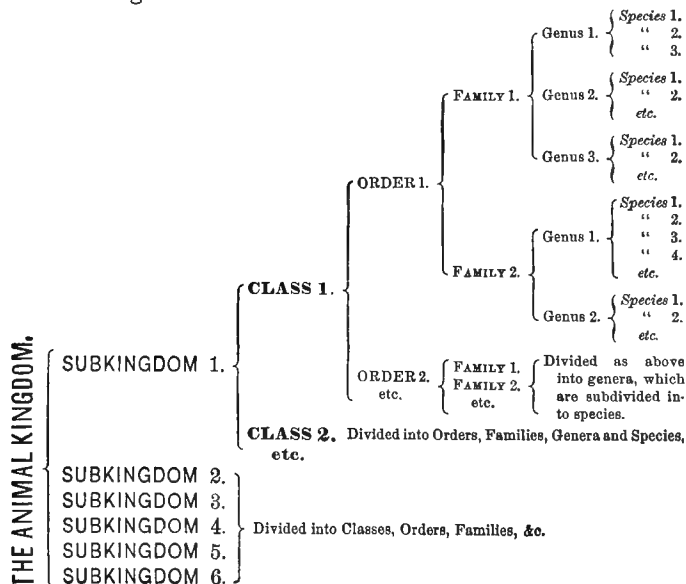
instance, their manner of procuring their food—we reach the divisions of each class, which we designate as **ORDERS**.

Observing the characteristics of the individuals of each Order with regard to their general form—as, for instance, the shape of the bill or structure of the tongue—we reach the divisions of each order, which we designate as **FAMILIES**.

Observing the characteristics of the individuals of each Family with regard to details of execution in special parts—as, for instance, the number and shape of the teeth—we reach the divisions of each family, which we designate as **GENERA** (*sing.*, Genus).

Observing the characteristics of the individuals of each Genus with regard to identity in every essential particular—as, for instance, color, size, corresponding measurements, etc.—we reach the divisions of each genus, which we designate as *Species*.

The following table exhibits the general plan of classifying the Animal Kingdom:



Particular names, which are, usually, descriptive of some peculiarity on which the classification is based, have been given to each of the divisions and subdivisions of the Animal Kingdom. Thus, the first subkingdom is called the Vertebrate, as it comprises all animals which have a vertebral column or backbone; the second subkingdom is termed the Articulate, since it contains those having a jointed body and limbs. The names and a general description of the six subkingdoms are given in the following table:

<p>THE ANIMAL KINGDOM.</p>	<p>Animals with a nervous system composed of</p>	<p>Ganglions and nerves only; no internal skeleton; blood usually white; a heart; senses more or less incomplete.</p>	<p>NERVOUS GANGLIONS UNITED ON A MIDDLE LINE IN A SORT OF LONGITUDINAL CHAIN, BODY DIVIDED INTO RINGS WITH AN EXTERNAL SKELETON FORMED BY THE SKIN, MORE OR LESS HARDENED.</p>	<p>NERVOUS GANGLIONS PLACED IN DIFFERENT PARTS OF THE BODY, AND BODY SOFT WITHOUT EXTERNAL SKELETON, BUT USUALLY PROTECTED BY A SHELL.</p>	<p>1st Subkingdom, Vertebrate Animals.</p>	<p><i>Examples: Mammals, Birds, Reptiles, Fishes.</i></p>
					<p>2d Subkingdom, Articulate Animals.</p>	<p><i>Examples: Insects, Lobsters, Worms, etc.</i></p>
					<p>3d Subkingdom, Molluscan Animals.</p>	<p><i>Examples: Cuttle-fishes, Clams, Snails, etc.</i></p>
	<p>Animals of a radiated structure.* Alimentary Canal</p>	<p>DISTINCT FROM BODY-CAVITY.</p>	<p>NOT DISTINCT FROM BODY-CAVITY.</p>	<p>4th Subkingdom, Echinodermatous Animals.</p>	<p><i>Examples: Sea-urchins, Star-fishes, etc.</i></p>	
				<p>5th Subkingdom, Cœlenterous Animals.</p>	<p><i>Examples: Jelly-fishes, Polyyps, Hydraz, Sponges, etc.</i></p>	
	<p>Animals very minute, of simple structure.</p>			<p>6th Subkingdom, Protozoans.</p>	<p><i>Examples: Infusoria, Rhizopods, etc.</i></p>	

* The Echinoderms and the Cœlenterates were formerly assigned to a single Subkingdom—RADIATES—and are often called by that name.

HINTS FOR PREPARING

LIGAMENTAL SKELETONS OF THE VERTEBRATES.

First remove all the muscle that can be conveniently taken off with knife and scissors, but leave the ligaments around the joints. The specimen should next be macerated (soaked) in soft water, with the addition of a little soda or potash, changing the water daily for a week, and then leaving it till the remaining muscle can be scraped off with the finger-nail or a tooth-brush, and the rotted brain be rinsed out with water. At this stage, while the skeleton is held beneath the surface of clean water, all fibres may be snipped off with scissors without injuring the ligaments, and the bones thoroughly cleaned without scraping them with any hard instrument. Next run a wire down the spinal cavity and bend the backbone into any desired position. Finally, hang up the skeleton by threads till dry.

Any animal larger than a fox should be cleaned, in the manner already described, of everything, even to the ligaments, and the bones wired together. Small skeletons of the size of a rat can be made ready for maceration and then put into a perforated box and placed in an ant-hill. These insects will quickly remove all the flesh, and the skeleton should be taken away as soon as they begin to attack the ligaments. Following these general directions, a little experience and a great deal of patience and perseverance will ensure success.

The Vertebrates.

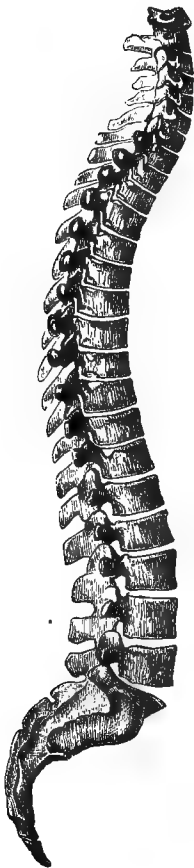
MAN—the lord of the Animal Kingdom—is constructed after the same type as the cat which purrs at his feet, the ox which he eats, the horse which bears his burden, the bird which sings in his gilded cage, the snake which crawls hissing across his pathway, the toad which hides in his garden, and the fish which swims in his aquarium. All are modifications of one creative thought, showing how the Almighty Worker delights in repeating the same chord, with infinite variations.

- VERTEBRATES. {
1. Mammals.
 2. Birds.
 3. Reptiles.
 4. Amphibians.
 5. Fishes.



I. SUBKINGDOM VERTEBRATA.

Fig. 2.



General Characteristics.—The Vertebrates are usually distinguished by a chain of small bones (vertebræ) to which the other parts of the skeleton are attached.* Certain modifications in the structure of these animals separate them into Classes, according to the following table:

SUBKINGDOM.		CLASSES.
VERTEBRATA. (producing eggs).	Viviparous (producing living young).	{ SUCKLE THEIR YOUNG ; LUNGS ; RESPIRATION SIMPLE ; BLOOD WARM ; CIRCULATION DOUBLE AND COMPLETE ; HEART FOUR-CHAMBERED. } <i>Mammalia.</i>
	RESPIRATION AERIAL ; WITH LUNGS.	{ Respiration double ; blood warm ; circulation double and complete ; heart four-chambered. } <i>Aves (birds).</i>
		{ Respiration simple ; blood cold ; circulation incomplete ; heart mostly three-chambered ; skull one occipital condyle (see Glossary). } <i>Reptilia.</i>
		{ Respiration simple when mature ; blood cold ; circulation incomplete ; heart three-chambered ; skull two occipital condyles. } <i>Amphibia.</i>
		{ Blood cold ; heart mostly two-chambered. } <i>Pisces (fishes).</i>
Oviparous (producing eggs).	{ RESPIRATION AQUATIC WHEN YOUNG, AERIAL WHEN MATURE, OR WITH BOTH LUNGS AND GILLS AQUATIC AND AERIAL. }	
RESPIRATION AQUATIC, WITH GILLS.	{ Blood cold ; heart mostly two-chambered. } <i>Pisces (fishes).</i>	

Vertebral Column.

* For a description of the vertebral column, and the advantages of its peculiar form, see "Fourteen Weeks in Physiology," page 27, et seq.

CLASS I. MAMMALIA.

General Characteristics.—To the class of Mammals belong man and those animals which resemble him in the most important parts of their organization. The distinguishing features are that they suckle their young, and that their bodies have, in general, a full or partial covering of hair. Some being designed for a life purely terrestrial, others mainly aerial or aquatic, they exhibit great variety of structure, as will appear in the following tabulation for Orders:

CLASS.		ORDERS	EXAMPLES.	
MAMMALIA.	}	WITH { ERECT, TWO-HANDED.....	Bimana.....	<i>Man.</i>
		HANDS. { NON-ERECT, FOUR-HANDED....	Quadrumana.....	<i>Monkey.</i>
		TEETH COMPLETE.....	Carnivora.....	<i>Cat, etc.</i>
		FOUR FEET HOOFED.....	Ungulata.....	<i>Horse, etc.</i>
		FEET PARTLY HOOFED.....	Hyracoidea.....	<i>Daman.</i>
		PROBOSIS.....	Proboscidea.....	<i>Elephant.</i>
		WHALE-LIKE, HERBIVOROUS.....	Sirenia.....	<i>Manatee, etc.</i>
		FISH-LIKE, CARNIVOROUS.....	Cetacea.....	<i>Whale, etc.</i>
		HAND-WINGED.....	Cheiroptera.....	<i>Bat.</i>
		CONICAL TEETH.....	Insectivora.....	<i>Mole, etc.</i>
		GNAWING TEETH.....	Rodentia.....	<i>Rat, etc.</i>
		TOOTHLESS.....	Edentata.....	<i>Sloth, etc.</i>
		POUCHED.....	Marsupialia.....	<i>Opossum, etc.</i>
		BIRD-LIKE.....	Monotremata.....	<i>Duckbill.</i>

ORDER BIMANA.

This order comprises only one family, and embraces a single genus and species; thus,

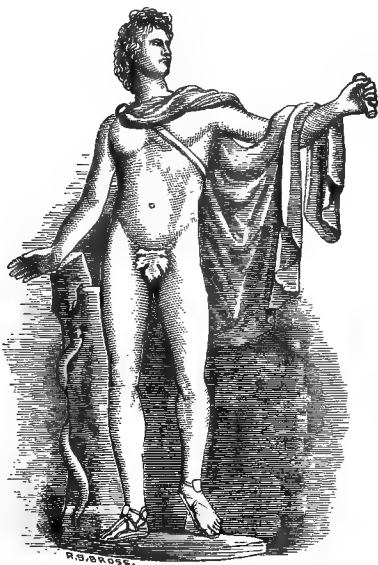
ORDER.	FAMILY.	GENUS.	SPECIES.	EXAMPLE.
BIMANA.	HOMINIDÆ.*	HOMO	sapiens,	<i>Man.</i>

General Characteristics.—Marked physical peculiarities distinguish man from the other mammals. Thus, the position of the spinal opening in the middle third of the base of the skull, thereby balancing the head and admitting an upright posture; the double curve of the vertebral column; the length of the thumb, extending to the middle of the index finger, and the ability of opposing the thumb to the

* By general consent of zoologists, the names of all Families terminate in *idæ*.

fingers; the power of placing the foot at right angles with the leg, the sole resting flat on the ground; the size and position of the great toe; the length of the arms, reaching

Fig. 3.



Apollo Belvedere.

half-way from the hip to the knees; the relatively great development of brain; the freedom of the anterior extremities from use in locomotion, and the consequent erect and biped position. In addition, man is the only mammal that truly walks; that is endowed with the power of speech; and that is cosmopolitan, readily adapting himself to extremes of heat and cold, and making his home in all parts of the globe. (See Fig. 5.)

There are intellectual and moral features, moreover, which place man high above all other ani-

mals. The scope of his mind and the possibilities of an immortal soul, mark the rank of a being who is alone declared to have been created "in the image of God."

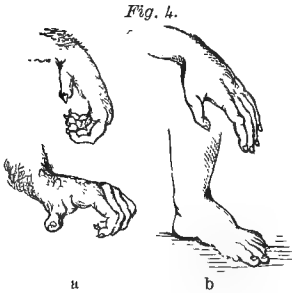
Common Origin of Man.—While in the human race there is but a single species, zoologists are accustomed to speak of several very distinctly-marked varieties. In respect to the dividing lines of the commonly-enumerated five races, authors disagree. So that, although there are some differences of structure and great diversity in the texture of the skin and the character of the hair of mankind in various localities, yet in the same nation there are similar varieties; and as marked diversities have repeatedly been observed in a

single species of the domestic animals. We therefore agree with Dr. Prichard "that no other differences occur than may fairly be attributed to the differences of external circumstances; and hence it may safely be concluded that the different races are all members of the same family, and the offspring of one common stock."

Dental Formula.—As the teeth present important characteristics for classifying the mammals, zoologists designate the number by a formula which, as applied to man, reads thus: $i \frac{2-2}{2-2}, c \frac{1-1}{1-1}, pm \frac{2-2}{2-2}, m \frac{3-3}{3-3} = 32$. This signifies that there are eight incisors, two on each side of each jaw; four canine teeth back of the incisors; eight premolars (bicuspid) back of the canine; and twelve molars back of the premolars.

ORDER QUADRUMANA.

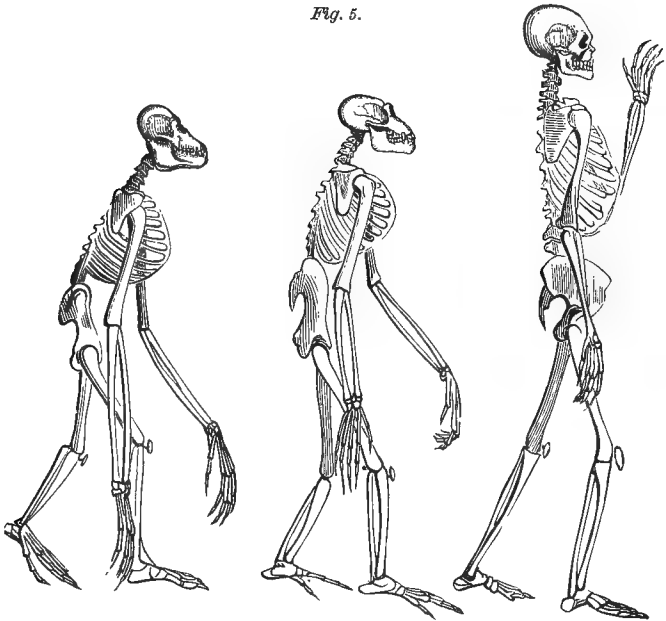
General Characteristics.—The peculiar feature of Monkeys is the power of opposing the great toe to the other toes, making the hind feet become hands and the animal quadrumanous or four-handed. They are further distinguished from man by the spinal opening in the cranium being in the posterior third of the base; by the single curve of the vertebral column; the shortness of the thumb, which does not reach the base of the index finger; the long and narrow pelvis; the impossibility of



a, *Monkey's hand and foot.*
b, *Human hand and foot.*

placing the foot at right angles with the leg, the sole resting on the ground; the relative length of the arms, which reach at least to the knee, and in some species to the ankle; the greater prominence of the canine teeth, etc.

Fig. 5.



Skeletons of Orang, Chimpanzee, and Man.

The order is divided into families as follows :

ORDER.	FAMILIES.	EXAMPLES.	
}	QUADRUMANA.	HEAD OBLONG; DENTAL FORMULA AS IN MAN; NOSTRILS CATARRHINE (oblique); NAILS FLAT ON ALL THE FINGERS.	Simiidæ. { <i>Monkeys of the Old World.</i>
		HEAD ROUND; $\frac{2-2}{2-2}, \frac{1-1}{1-1}, \frac{3-3}{3-3}, \frac{3-3}{3-3} = 36;$	Cebidæ. { <i>Monkeys of the New World.</i>
		NOSTRILS PLATYRHINE (wide apart); NAILS SOMEWHAT COMPRESSED.	
		HEAD POINTED; DENTITION AS IN CEBIDÆ; NOSTRILS STREPSORHINE (twisted); NAILS FLAT EXCEPT A LONG CURVED CLAW ON THE FIRST FINGER, SOMETIMES THE FIRST TWO FINGERS OF THE HIND FEET.	Lemuridæ. { <i>Monkeys of Madagascar.</i>

Simiidæ.—The *Catarrhine Monkeys*, with the exception of a single species found upon the Rock of Gibraltar, belong to Asia and Africa. This family comprises animals which

greatly vary in their organization and lead down by degrees from man to the common animals, as is shown in the following table:

FAMILY.		GENUS.	SPECIES.	EXAMPLES.	
SIMIIDÆ, or CATARHINE MONKEYS.	Without tails	ANTHROPOID APES.			
		WITHOUT POSTERIOR CALLOSITIES.*		Troglodytes niger, (Black cave-dweller.)	<i>Chimpanzee.</i>
				Troglodytes gorilla,	<i>Gorilla.</i>
				Simia satyrus, (Snub-nosed satyr.)	<i>Orang-outang.</i>
		WITH POSTERIOR CALLOSITIES.		Hylobates agilis, (Agile wood-walker.)	<i>Agile Gibbon.</i>
				Hylobates syndactylus, (Yoke-fingered.)	<i>Siamang.</i>
	With tails	MONKEYS PROPER.			
		MUZZLE ROUNDED, WITHOUT CHEEK-POUCHES.†		Semnopithecus entellus, (Revered ape.)	<i>Sacred Monkey.</i>
				Semnopithecus nasica,	<i>Proboscis Monkey.</i>
		MUZZLE MORE OR LESS PROJECTING, WITH CHEEK-POUCHES.		Colobus polycomus, (Mutilated.)	<i>Colobe.</i>
		Cercopithecus mona, (Tailed ape.)	<i>Guenon.</i>		
		Cynocephalus mormon, (Dog-headed.)	<i>Mandrill.</i>		

Fig. 6.



Troglodytes niger, Chimpanzee.

Anthropoid Apes.—The *Chimpanzee* bears the greatest resemblance to man, though inferior in stature and strength. Like the *Gorilla*, it has its home in the dense forests of Western Africa. Both have been represented as dwelling in huts built in trees and snatching up the unwary traveler who

* The posterior callosities are hardened protuberances, to obviate friction when the animal takes a sitting posture.

† The cheeks of some monkeys are capable of being greatly expanded, so as to form a sort of temporary larder in which the monkey lays by its food or carries it off.

Fig. 7.



Troglodytes gorilla, Gorilla. 7.

passes beneath; whereas they generally remain upon the ground, eat fruits and vegetables, and merely bend down branches for a seat and, perhaps, for concealment.

The *Orang* differs more widely from man, and is adapted to an arboreal life. It inhabits Southern Asia. In the wild state it is frugivorous (fruit-feeding), not even eating eggs, though the teeth are adapted to either vegetable or animal food. Matured orangs of the same species and sex vary in height from five to over seven feet.

The *Gibbon* is distinguished by the length of its arms and the slenderness of its form. With a height of three feet, the reach of the extended arms is six feet, enabling it to swing through the air among branches twenty feet apart.*

Fig. 8.

*Hyllobates agilis*, Gibbon.

Fig. 9.

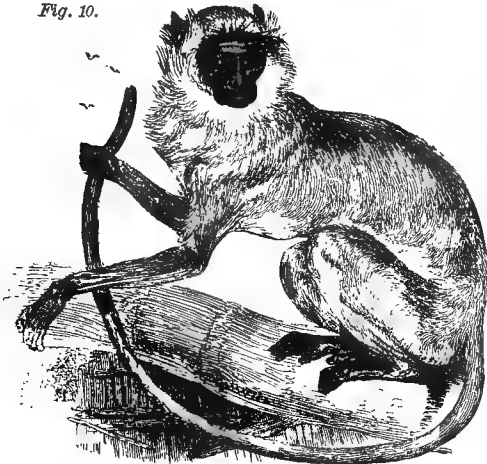
*Hyllobates syndactylus*, Siamang.

The *Siamang* derives its specific name from the adhesion of the first and second fingers as far as the joint which bears the nail. The posterior callosities of this genus link it to the

* When the *Ateles* wish to cross a river, the strongest ascend a high tree overlooking the stream. The leader hooking his tail firmly to a limb drops downward, while the next attaches himself to his predecessor, and so on, forming at last a long chain of monkeys. This swings to and fro until the end monkey grasps a limb upon the opposite bank. Along this living suspension bridge the troop pass over, a mischievous monkey occasionally playing off a practical joke on some member as he hurries forward. To get the bridge across, the first monkey lets go and the chain swings over, perhaps ducking one or two, when all unfasten and catching at the branches, descend to the ground. (See page 25, Fig. 16.)

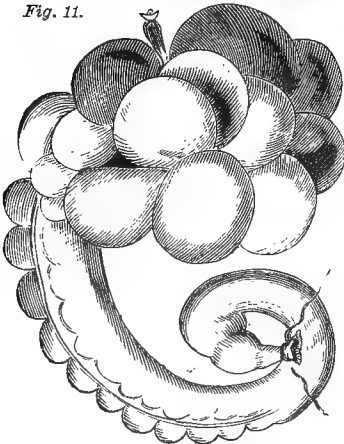
monkeys* proper, which have tails and cheek pouches, or some equivalent modification of the digestive organs.

Fig. 10.



Semnopithecus entellus, Sacred Monkey. $\frac{1}{15}$.

Fig. 11.



Stomach of a *Semnopithecus*.

Fig. 12.



Semnopithecus nasica,
Proboscis Monkey. $\frac{1}{15}$.

* The term Monkey is properly applied to those Simiidæ having tails, which serve like a balancing-pole to the rope-dancer or as a rudder to guide the animal in its leaps through the air.

Monkeys Proper.—The *Semnopithecus* lacks the cheek-pouches, but is compensated by a stomach with distinct sacs. The *Sacred Monkey* receives divine honors from the natives of India, who believe it a metamorphosed prince, and punish its slaughter by death, although a trifling fine compounds for the murder of a man.* It is permitted to ravage their gardens at will.

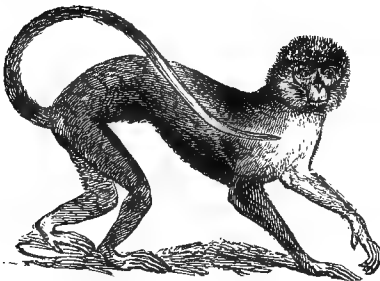
The *Proboscis Monkey* of Borneo has a flabby nose, six inches long and capable of enormous inflation.

Fig. 13.



Colobus polycomus, Bear Monkey. $\frac{1}{2}$.

Fig. 14.



Cercopithecus mona, Guenon. $\frac{1}{3}$.

The *Colobe* (mutilated) is named from its lacking a thumb on the anterior extremity. The long white hair of its head falls over the back like a cloak.

The *Guenon* approaches the ape in the shortness of its muzzle. With bushy whiskers and varied colors, it is the fop of the monkeys. Its cheek-pouches will contain two days food. Driven by famine, it descends into the fields and commits great havoc. Docile in nature, it is easily tamed, but is an arrant thief, and while gravely receiving caresses will pick the pocket of its confiding admirer.†

* It may have become interwoven so remarkably with the superstition of the Hindoos on account of being an expert serpent-killer.

† The last two genera, with others, include a great number of species which inhabit Africa—the headquarters of the monkey tribe. It is believed that each is restricted to a small territory and jealously guards any intrusion.

The *Baboon*, with its dog-like muzzle, is the ugliest and most ferocious of the monkeys. It dwells among craggy rocks, which it climbs with great agility. Its food consists of bulbous roots, eggs, insects,* etc. In this tribe the *Mandrill* is conspicuous for its variety of color—its nose being red, with a bright scarlet tip; its cheeks, a brilliant blue; its beard, citron-yellow; its hind-parts violet; and its body a grayish brown, tinged above with olive.

Fig. 15.

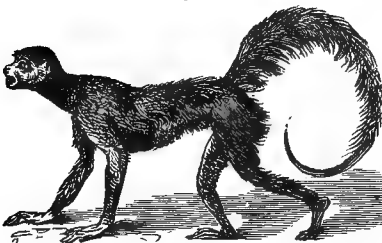


Cynocephalus mormon, Mandrill. $\frac{1}{10}$.

Cebidæ.—The *Platyrrhine* monkeys are found in great numbers climbing among the trees in the forests of South America. Having no callosities, cheek pouches, or opposable thumbs, they are classified according to the differences in the tails:

FAMILY.		GENUS.	SPECIES.	EXAMPLES.
CEBIDÆ, or Platyrrhine Monkeys.	{ TAILS PREHENSILE, (able to grasp). { TAILS NON-PREHENSILE.	Ateles	pentadactylus,	<i>Spider Monkey.</i>
		Mycetes	ursinus,	<i>Bear Howler</i>
		Brachyurus	cacajao,	<i>Saki.</i>
		Hapale	jacchus,	<i>Marmoset.</i>

Fig. 16.

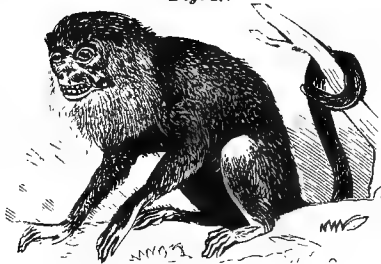


Atèles pentadactylus, Spider Monkey. $\frac{1}{3}$.

The *Atèles*, or four-fingered monkey, has no thumb on the anterior extremity. On account of the length, flexibility, and slenderness of its limbs, it is termed the *Spider Monkey*. The tail is prehen-

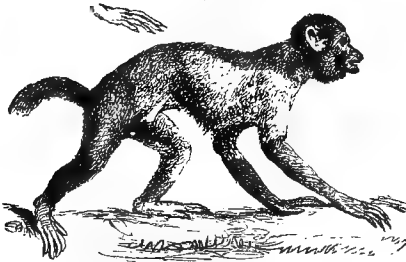
* It devours scorpions with great dexterity, whipping off their stings so quickly as to give them no chance to strike it.

Fig. 17.



Myocetes ursinus, Bear Howler. 13.

Fig. 18.



Brachyurus cacajao, Saki. 16.

sile, and the end being bare and sensitive, can be used as a fifth hand to pick up small objects or to insert into the hollows of trees to hook out eggs. The *Bear Howler* has the power of dilating the larynx so as to render the voice louder than the roar of a lion, having been heard two miles off. The *Saki* is a striking example of the non-prehensiles, as its tail is short and so covered with hair as to look in some species like a mere knob.

Fig. 19.



Haple jacchus, Marmoset. 13.

The *Marmoset*,* by its sharp, crooked claws, and the short thumb on its hind feet, stands at the extreme of the monkey tribe in America. Its food is not grasped by the fingers, but held between the forepaws. Several species have tufts of hair projecting from the sides of the head.

Lemuridæ. — The Lemurs † have opposable thumbs like the Simiidæ, and their dentition is the same as the Cebidæ; while, unlike both, they have a long, curved claw on the first, sometimes on the first two fingers of the hind feet. The true Lemurs are found only in the forests of Madagascar. The presence or absence of tails furnishes a basis of tabulation.

Fig. 20.



Hand and foot of Lemur.

FAMILY.
LEMURIDÆ,
 or Strepsorhine
 Monkeys.

TAILS. { TAIL PREHENSILE.
 { TAIL NON-PREHENSILE.
 TAILLESS, OR RUDIMENTARY.

GENUS.	SPECIES.	EXAMPLES.
{ Lemur	macaco,	<i>Ruffled Lemur.</i>
{ Cheiromys	madagascariensis,	<i>Aye Aye.</i>
{ Perodicticus	potto,	<i>Bush-dog.</i>
{ Loris	gracilis,	<i>Graceful Loris.</i>

Fig. 21.



Lemur macāco, Ruffled Lemur.

The *Ruffled Lemur* is the largest and handsomest of this family. Wrapped up in its long, bushy tail, it passes the day in sleep, and only comes forth at night to search for food. The

* This little creature is only six or eight inches in length, and a century ago was held in great estimation as a pet by ladies of quality. So great is its fondness for insects, that it has been known to tear out the pictures from an Entomology and greedily swallow the printed scraps!—(Wood.)

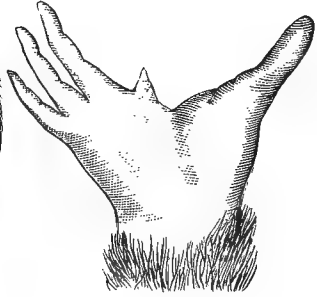
† Lemur means spectre, and is descriptive of the nocturnal habits and stealthy step of the animal. In fact, it is known among sailors as the "Madagascar Cat."

Aye Aye has some resemblance to a squirrel, but the form of its head and limbs allies it to the Lemur.* The middle

Fig. 22.

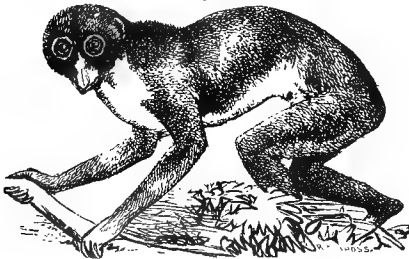
*Cheiròmys madagascariensis*, Aye Aye.

Fig. 23.

Hand of *Bush-dog*.

finger of its fore leg, long, slender and hairless, is adapted to extract worms from their holes in the ground or in trees.

Fig. 24.

*Loris gracilis*, Graceful Loris.

The *Bush-dog* is marked by the absence of the first finger of the hand. The *Graceful Loris* inhabits Ceylon, Java, etc. Prowling through the darkness, it is almost invisible, save for its round, shiny eyes. Espying a sleeping

bird among the branches, it creeps toward it with noiseless, imperceptible movements, until it can place its fingers over its prey, when it seizes it with a spring sudden as a flash.

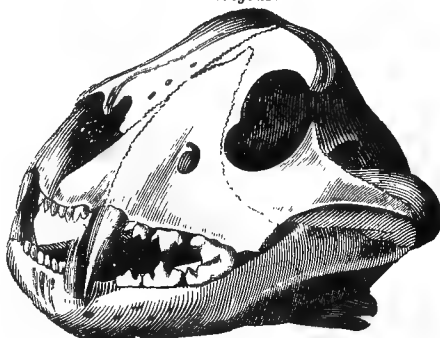
ORDER CARNIVORA.

General Characteristics.—This order includes the flesh-eating animals. Strong, agile, and with senses highly devel-

* It is an illustration of what is known as a comprehensive type, since it possesses peculiarities which link it to different orders—the *Quadrumana* and the *Rodents*.

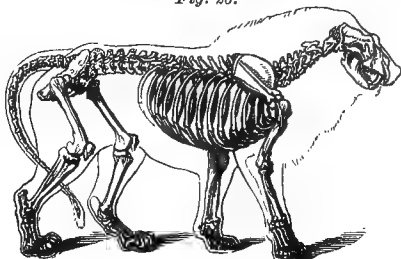
oped, they are organized for slaughter. Among their anatomical peculiarities are: (1), their dentition, marked by long, sharp canine teeth, and a molar on each side, above and below, larger and sharper than the others, known as the "carnivorous tooth," and used for crushing bones; and (2), their feet, which are provided with toes and often armed with claws. The difference in these physical features affords the basis of a classification.

Fig. 25.



Skull of a Carnivorous Animal.

Fig. 26.



Skeleton of a Lion.

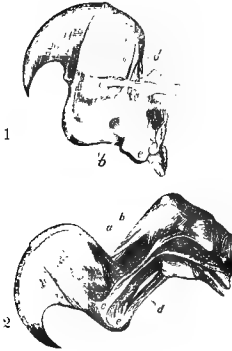
CARNIVORA.

{	6	1-1	2-2	2-2
	6	1-1	2-2	1-1
	6	1-1	3-3	3-3
	6	1-1	4-4	2-2
	6	1-1	3-3	2-2
	6	1-1	3-3	1-1
	6	1-1	3-3	3-3
	6	1-1	4-4	3-3
	6	1-1	2-2	2-2
	6	1-1	3-3	2-2
	6	1-1	4-4	2-2
	6	1-1	4-4	3-3
	6	1-1	4-4	2-2
	6	1-1	4-4	2-2
	6	1-1	4-4	2-2
	6	1-1	5-5	
5	1-1	5-5		
6	or 4,	or 4	rudi- 5-5	
4	4	2	mentary 5-5	
2	1-1	indefinite		
0	0-0			

	FAMILY.	EXAMPLES
claws retractile,	Felidæ,	<i>Lion, etc.</i>
claws semi-retractile,	Viverridæ,	<i>Civet.</i>
claws non-retractile,	Hyenidæ,	<i>Hyena.</i>
claws non-retractile,	Canidæ,	<i>Dog, etc.</i>
claws non-retractile,	Mustelidæ,	<i>Weasel, etc.</i>
claws non-retractile,	Ursidæ,	<i>Bear.</i>
claws non-retractile,	Procyonidæ,	<i>Raccoon.</i>
claws non-retractile,	Bassaridæ,	<i>Civet Cat.</i>
claws on posterior feet only,	Otariidæ,	<i>Eared Seal</i>
claws on all the feet,	Phocidæ,	<i>Seal.</i>
claws on posterior feet only,	Rosmaridæ,	<i>Walrus.</i>

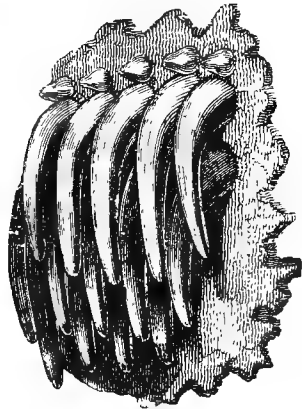
Felidæ.—The Cats form the typical family of this order. They are all *digitigrade* (toe-walkers). Lest their claws should be blunted by coming in contact with the ground or impede their progress by getting entangled in the grass, they are *retractile*, *i. e.*, the upper tendons of the foot hold them back without any exertion of the will. Resting upon its soft, padded feet, and with its claws sheathed, the animal steals noiselessly toward its prey. As the fatal spring is made, the lower muscles suddenly contract, and, drawing the claws forward, bury their sharp points in the victim's

Fig. 27.



1. Claw Sheathed.
2. Claw Extended.

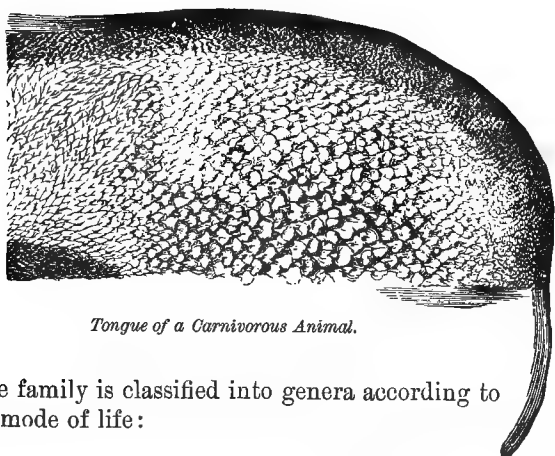
Fig. 28.



Tongue of a Carnivorous Animal
Highly Magnified.

flesh. The tongue is covered with innumerable little hooks, pointing backward. These are for rasping the bones which it gnaws for food, and beautifully illustrate the economy of Nature, which allows no waste. The whiskers on the upper lip are of great service to the animal while skulking about in the darkness, seeking its food. They equal the body in width, and by indicating the breadth of any opening, warn it from attempting too close a bush, and thus causing a rustle which might alarm its prey.

Fig. 29.



Tongue of a Carnivorous Animal.

The family is classified into genera according to their mode of life:

FAMILY		GENUS.	SPECIES.	EXAMPLE.	
FELIDÆ.	{	Terrestrial.	Felis	leo,*	Lion.
			"	tigris,	Tiger.
			"	concolor,	Puma.
	Terrestrial and arboreal.	"	leopardus,	Leopard.	
		"	onça,	Jaguar.	
	Arboreal.	"	domestica,	Domestic Cat.	
Lynx		canadensis,	Common Lynx.		
	"	rufus,	Wild Cat.		

The *Lion* is known as the "King of Beasts," more from his majestic appearance than any nobleness of disposition.† The tail is tufted, while the neck of the male is ornamented with a flowing mane that in some varieties reaches nearly to the ground.‡ His tawny, uniform color, closely correspond-

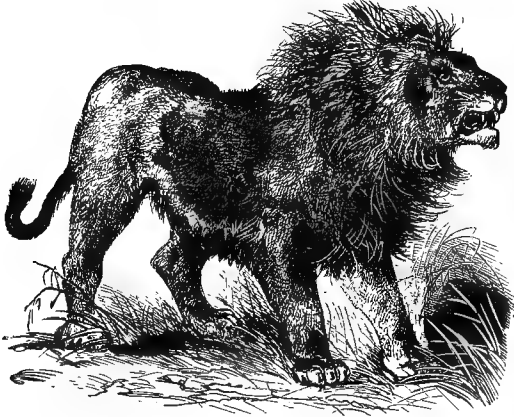
* Zoologists have described different species of the lion, but they are now considered only geographical varieties distributed over Africa and southern Asia.

† Livingstone and Gérard pronounce him cruel and cowardly. He secures his prey by lying in ambush till it comes within reach of his terrible bound, and if the first spring fails, like the tiger, he sneaks back to his covert ashamed and disappointed. In fact his speed is too slow to permit his overtaking his game.

‡ It is asserted by some travelers that the roar of the lion is terrific beyond description, while others declare it to resemble the discordant cries of the ostrich. Probably the degree of fear aroused colors the narration. Since the lion's larynx is relatively larger than that of any other mammal, there may be no exaggeration in the statement that its roar sometimes shakes the ground like an earthquake, and carries dread to every animal within hearing.

ing to that of the desert tracts in which he lives, aids his concealment in stealing upon his prey. The pupil of his eye is round, giving as extensive horizontal vision as vertical;

Fig. 30.



Felis leo, Lion. $\frac{1}{5}$.

and his strength is such that he can carry off a cow with ease, even leaping broad dikes and keeping ahead of pursuing horsemen for miles without dropping it. He naturally feeds

Fig. 31.



Tuft of Lion's Tail, showing hook.

at night, so that his apparent magnanimity in sometimes sparing man and beast during the day is only because he is already satiated with food. Like other animals, he has no desire to kill merely for the sake of killing.

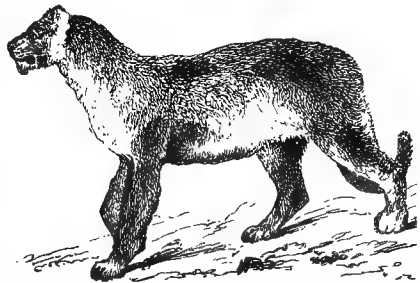
Fig. 32.

*Felis tigris*, Tiger. 16.

The *Tiger*, being destitute of a mane and tail-tuft, lacks the noble bearing of the lion, but is beautifully decorated with black stripes upon a ground of reddish-yellow fur, tending to white beneath. Its ferocity, especially that of the dreaded "man-eater," is fearful, while its strength enables it to carry off a buffalo thrown over its shoulder. Inhabiting Southern Asia, its home is in the long jungle-grass, with the coloring of which its stripes so exactly assimilate that it is impossible for unpracticed eyes to discern it at even a short distance. This adaptation of the color of an animal to that of surrounding objects in its native wilds is termed *mimicry*, and is one of the most wonderful provisions of Nature.

The *Puma** inhabits North and South America. Its uniform dun color gives a *mimicry*

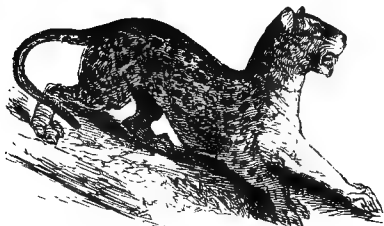
Fig. 33.

*Felis concolor*, Puma.

* In different parts of the continent the puma is styled the "painter," the "panther," the "cougar," and even the "catamount," though there is no panther in America, and the true catamount is the wild cat of Europe.

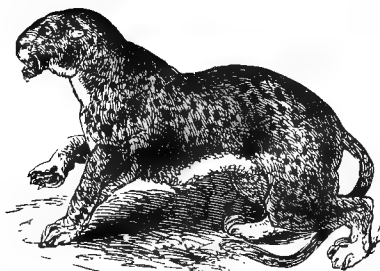
for its protection while crouching upon the branches of trees. Having a black tail-tuft and a sameness of color, it has been called the "American Lion," though none of its habits

Fig. 34.



Felis leopardus, Leopard. $\frac{1}{2}$.

Fig. 35.



Felis onça, Jaguar. $\frac{1}{3}$.

Fig. 36.



Felis domestica, Cat.

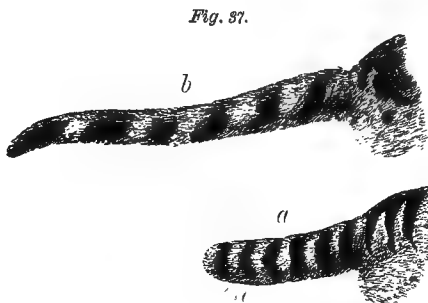
resembles those of its African namesake.

The *Leopard*, now considered identical with the panther, inhabits Africa, India, and the adjacent islands. Smaller than the Tiger, it is as beautiful and its mimicry as striking—its skin being marked with circles of dark spots instead of stripes, corresponding to the leaves of the tree among which it conceals itself.

The *Jaguar*, inhabiting the warmer parts of America, is the analogue (see Glossary) of the Leopard, though more powerful, being able to carry off a horse with ease. The

circles upon its sides have a black spot in the centre, well calculated to deceive the eye as the animal glides through the dense foliage of the tropical forests in pursuit of monkeys, swims in the lagoons for turtles, or prowls around the herds of cattle for larger prey.

Domestic Cat.—No wild animal is known that can be the original of the domestic cat, though there are several which bear some resemblance to it. There is a marked difference in the tail of the wild and the domestic species. Still greater variations, however, are found in dogs of the same race.*



a. Tail of Wild Cat.
b. Tail of Domestic Cat.

The *Lynx* is anatomically distinguished by having two less molars in the upper jaw. Only two species are found in North America—the *Canada Lynx* and the *Wild Cat*. The former has its ears tipped with pencil-like tufts of black hair, while its prevailing color is gray with a wash of black. It

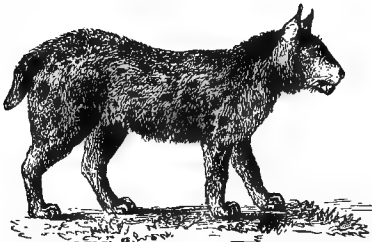


Lynx canadensis, Lynx. $\frac{1}{2}$.

* Probably, animals designed by the Creator for domestication, have inherent tendencies to variation in form and color, according to climatic and alimentary influences, so that individuals may be more readily recognized. See note p. 39.

lives upon birds and small mammals, pursuing them among

Fig. 39.



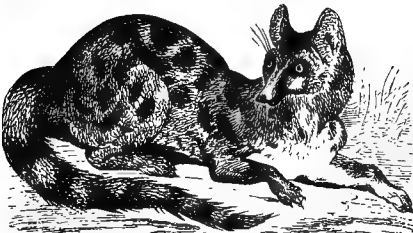
Lynx rufus, Wild Cat. $\frac{1}{2}$.

Fig. 40.



Viverra civetta, Civet. $\frac{1}{2}$.

Fig. 41.



Viverra genetta, Genet. $\frac{1}{2}$.

the branches of the trees as well as upon the ground. Its gait is by bounds with all four feet at once, the back being arched. The Wild Cat may be recognized by its lacking long ear-tufts, and by having the inside of the legs banded or spotted.

Viverridæ.—The *Civet* is the type of this numerous and varied family. The true civet has semi-retractile claws. It is also characterized by a double pouch, secreting a fatty substance used as a perfume; and by the pupil of the eyes being circular during the day instead of vertical, as in the Cats.

The *Genet* has retractile claws. It wages war on rats and mice,* and in many parts of the east is domesticated. The *Ichneumon* is semi-plantigrade, and has the pupils elongated transversely. It preys on the eggs and

young of the crocodile and various reptiles.

* The ancient Egyptians gave it free access to their houses and paid it divine honors. It is sometimes called "Pharaoh's Rat."

Fig. 42.

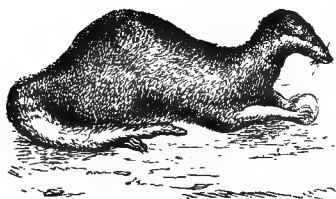
*Viverra ichneumon*, Ichneumon. $\frac{1}{3}$.

Fig. 43.

*Hyena vulgaris*, Hyena. $\frac{1}{3}$.

Hyenidæ.—The *Hyenas* are peculiar to the warmer regions of the Old World. The enormous strength of their jaws and the size of their blunt molar teeth, enable them to crush the largest bones, which they swallow without mastication. In adult animals, the vertebræ of the neck often grow together, enabling them to endure a violent strain. The toes are four, with blunt, non-retractile claws. The bending of the hind legs makes them seem shorter than the fore legs and gives an awkward shuffle to the pace. The hyena is the true scavenger among the mammals, removing offal which would endanger the health of man.*

Canidæ.—The *Dogs* have the muzzle more elongated, and hence the jaws weaker than the previous Families. The teeth are blunter, and the toes, five in front and four behind, are armed with non-retractile claws adapted to burrowing in the ground. The dog never perspires, even in the hottest weather. It drinks by lapping,† and so avoids the danger of swallowing large quantities of cold water when the body is overheated. The shape of the pupil affords a basis for tabulating:

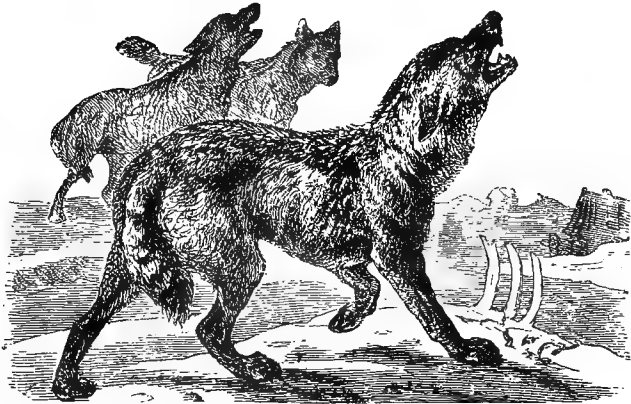
CANIDÆ,	$\left\{ \begin{array}{l} \text{Pupil round.} \\ \text{Pupil vertical.} \end{array} \right.$	$\left\{ \begin{array}{l} \text{Canis lupus,} \\ \text{Canis familiaris,} \\ \text{Canis aureus,} \end{array} \right.$	$\left. \begin{array}{l} \text{Wolf.} \\ \text{Dog.} \\ \text{Jackal.} \end{array} \right.$
		Vulpes vulgaris,	Fox.

* Its work is most useful, as it consumes even the skeletons of the decaying carcasses on which it feeds. In performing this mission, its occasional attacks upon graveyards have, however, given it an unenviable reputation.

† In lapping, Felidæ turn the tip of the tongue backward, and Canidæ forward.

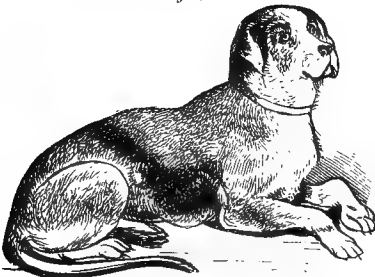
The *Wolf*, of which there is now considered to be but one species in North America, is the best representative of the Family. It generally hunts in packs. Unless impelled by

Fig. 44.

*Canis lupus*, Wolf. $\frac{1}{5}$.

hunger,* they seldom attack prey larger than themselves, and they are so wary of traps that a traveler, when pursued, has frightened them away by merely trailing a cord. Their

Fig. 45

*Canis familiaris*, Mastiff.

bite, unlike that of any other animal, is a succession of quick, violent snaps.

The Dog.—Of all the conquests achieved by man over animals, that of the dog is the most complete, and, perhaps, the most useful. Not only is he the sole mammal that has fol-

* Such is then their rapacity that they will make a meal of a harness or even of old shoes that may be within their reach.

lowed man to the ends of the earth, but more than any other is he capable of education and disinterested affection. His habit of repeatedly turning round before lying down is regarded as a singular retention of his mode in the wild state* of making a lair in the tall grass. The dog attains maturity in two years, and lives from fifteen to twenty.

The *Jackal* derives its specific name from the golden tint of its skin. Likē the wolf, it hunts in bands; but it associates more intimately with man, acting the scavenger in consuming the street offal in the filthy towns of the East.†

The *Fox* is mostly nocturnal, springing upon its prey as it passes by, or stealing upon it while asleep. Its dentition is



Canis aureus, Jackal. 1/2.

calculated for a mixed diet, so that mammals, birds, molluscs, and even grapes, furnish a dainty meal. Its characteristic is craftiness.‡ Its maternal instinct is also highly developed, and it will peril its life to save its young.

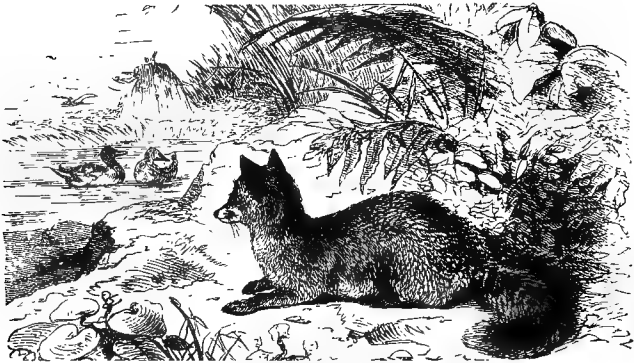
* The canine race, like the human, inherently adapted to variation and development, through the influence of climate and condition, presents innumerable varieties; though all are considered by most naturalists as having a common origin and to be regarded of one species. Many have supposed the wolf to be the progenitor of the dog. But, while the osteological structure of the two is identical, the total want of similarity in disposition, especially in affection for man, their hostility to each other, and their permanent physical differences—as the obliquity of the wolf's eye, and its drooping tail—oppose this theory. Besides, it is as reasonable to presume that the wolf descended from the dog, as the dog from the wolf. But no wild dogs—as, for instance, those of the Antilles, known to have sprung from domestic varieties—have ever approximated the characteristics of wolves. Hence, with Prichard, we conclude, "As with the race of man, so with the race of dogs, the varieties have become permanent from one original pair." It is, however, a mooted question.

† In uninhabited regions, it often feeds upon the remnants of carcasses left by lions, and hence the absurd idea that it is the companion of that beast, and runs down his prey for him.

‡ A hunted fox will run a long way in a straight line, then doubling on its track, suddenly spring off to a great distance one side and quietly steal away, while the hounds are eagerly following up the scent; it will leap from tree to tree, and hide in some convenient hollow; it will perfume itself with any odorous substance it may

Different species abound in all parts of the world.*

Fig. 47.



Vulpes vulgāris, FOX. $\frac{1}{2}$.

Mustelidæ.—The *Weasels* are greatly diversified in size, habits, color, etc. All have fine fur, short legs, and slim, flexible bodies, which enable them by gliding movements to pursue their prey through small openings. Nearly all have glands secreting a disagreeable odor. Differences in dentition and manner of walking afford a means of tabulation :

MUSTELIDÆ.	{	Terrestrial.	{	DIGITIGRADE.	{	TEETH = 38.	{	<i>Mustela pennantii</i> ,	<i>Fisher.</i>
						TEETH = 24.	{	<i>" americana</i> ,	<i>Sable.</i>
			SEMI-DIGITIGRADE.	{	TEETH = 31.	{	<i>" ermineus</i> ,	<i>Weasel.</i>	
					TEETH = 36.	{	<i>" lutreolus</i> ,	<i>Mink.</i>	
	{	Aquatic.		{	TEETH = 31.	{	<i>Mephitis mephitica</i> ,	<i>Skunk.</i>	
				TEETH = 38.	{	<i>Taxidea americana</i> ,	<i>Badger.</i>		
					TEETH = 36.	{	<i>Gulo luscus</i> ,	<i>Wolverine.</i>	
						TEETH = 36.	{	<i>Lutra canadensis</i> ,	<i>Otter.</i>

The *Fisher* and the *Sable* are the representatives of the Genus *Mustela* in North America. The former is the largest

meet, in order to deceive the dogs; it will run at full jump to the crest of a hill, then quickly lie down, while the headlong speed of its pursuers carries them pell-mell to the bottom; and even if caught it will feign death, permitting itself to be handled, kicked about, and carried away, without showing any sign of life until a chance of escape offers, when it will suddenly dash off to the intense surprise of those whom it has so cleverly duped.

* So varied, however, are their individual markings according to age and locality, that naturalists disagree as to the number of species in North America, or whether there is more than one genus.

of the known species. Its long head and bushy tail, resembling those of the Fox, mark the transition from the Canidæ to the Mustelidæ. The *Sable* is arboreal, climbing with ease to the highest branches in pursuit of birds and eggs. Its fur will lie smoothly in any direction.

The *Weasel*, at the north, during summer, is reddish-brown above and white beneath. It changes from brown to white in October and November, and back again in

Fig. 48.

*Mustela pennanti*, Fisher. $\frac{1}{16}$.

Fig. 49.

*Mustela americana*, Marten or Sable. $\frac{1}{4}$.

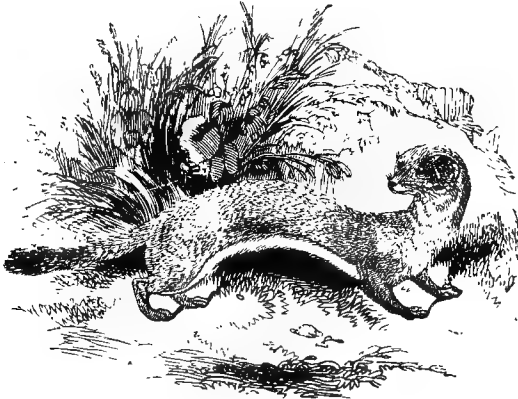
March, except the extremity of the tail, which is always black. At the south, the same species does not vary its fur.

Fig. 50.

*Putorius ermineus*, Weasel in winter. ♂.

These alterations are effected, not by shedding the coat, but by changes in the color of the hair. Weasels destroy mice, and hence are beneficial to farmers.*

Fig. 51.

*Putorius ermineus*, Weasel in summer. ♂.

* Their carnivorous propensities are, however, not unfrequently displayed in the hen-roost. An ermine has been known to kill forty full-grown fowls in a single

The *Mink* is brown, with a white spot under the chin. It is semi-digitigrade and semi-palmate (webbed), being thus fitted for hunting in the streams for fish, frogs, etc.

The *Skunk* is striped with black and white; but individuals of the same species differ in their markings. It emits in self-defence an intolerable odor, that no other animal can endure. The

fore feet are adapted to digging holes, in which it hibernates without becoming torpid—entering its retreat in the fall, fat, and coming out in the spring, lean.

The *Badger*, inhabiting the northern part of the continent, has long silky hair and short tail. Its stout claws are well adapted for burrowing. Though so peaceable as

to resign its nest without a struggle to those much weaker than itself, it can bite more fiercely than any animal of its size. Its skin is so loose and thick, that while the teeth of its assailants can make little impression upon it, the badger can turn itself round in it, so as to bite them in their tenderest parts. It feeds upon small animals, which it

Fig. 52.

*Putorius lutreolus*, Mink. $\frac{1}{2}$.

Fig. 53.

*Mephitis mephitis*, Skunk. $\frac{1}{2}$.

night, as it devours the brain and sucks the blood, but never eats the flesh of an animal. Its mode of attack is to pounce upon its prey transversely, and piercing the brain at a single bite, to throw itself lengthwise upon the body, to which it clings until the death of its victim. Its ability to bend the head at right angles with the neck facilitates this mode of attack.—Ermine skins have long been used in England to decorate the robes of judicial officers, and hence their association with ideas of moral purity.—The expression "catch a weasel asleep" is based upon the ease with which the animal may be caught when sleeping, on account of the soundness of its slumbers.

digs out of their burrows, leaving dangerous trap-holes for the unwary traveler.

Fig. 54.



Taxidea americana, Badger. $\frac{1}{2}$.

The *Wolverine* inhabits the northern parts of Europe and America. Extravagant stories are told by trappers of its strength and ferocity,* whereas it is harmless to man, and

Fig. 55.



Gulo luscus, Wolverine or "Glutton." $\frac{1}{16}$.

only annoying by devouring animals caught in traps, and by destroying the hunter's hoards. With a sagacity rarely permitting it to be ensnared, it skillfully tears the trap to pieces, and carries off the bait.

The *River Otter* has but one species in North America, though it ranges from Hudson's Bay to the Gulf of Mexico. Its webbed feet exhibit

* Thus we are gravely informed that the Wolverine will drop from a tree upon the back of an animal passing underneath, and, clinging to its neck with long trenchant claws, tear open the blood-vessels until the poor victim falls lifeless.

an approach to the amphibious mammals. The peculiar position of its eye enables it, with a slight motion of the head, to see the fish on which it preys, whether swimming above, below, beside, behind, or before. It burrows in the

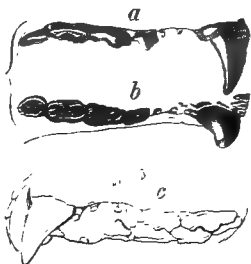
Fig. 56

*Lutra canadensis*, Otter. $\frac{1}{4}$.

banks of streams, forming the entrance under water, and providing numerous cells to occupy, according to the height of the stream. Its pastime of sliding in companies into the water, down a snow-bank in winter and a slippery clay-bank in summer, presents a singular feature of animal life.

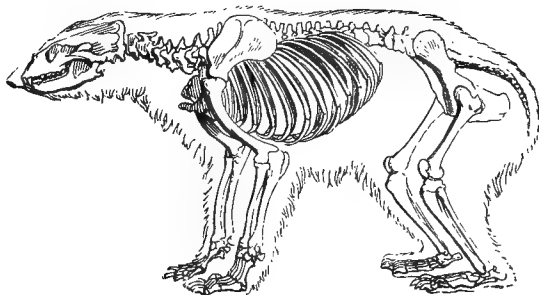
Ursidæ.—The Bear is a typical example of a plantigrade (see Glossary). The entire sole of the foot applied to the ground: the broad, flat crowns of the molars; large, curved, non-retractile claws; smooth tongue: mobile nose; circular pupils, and short tail, exhibit such variations from the strictly carnivorous animals as betoken different habits of life. Bears are carnivorous

Fig. 57.



a. Side view of Bear's upper jaw.
 b. Top view of Bear's lower jaw.
 c. Side view of jaws shut.

Fig. 58.



Skeleton of Bear.

only from necessity, their preference being for roots, nuts, honey, and even insects. The single American genus is thus tabulated:

URSIDÆ.	{	Terrestrial only.	{	SOLES OF THE	}	Ursus horribilis, <i>Grizzly Bear</i> .
		Terrestrial and arboreal.		FEET NAKED.		" americanus, <i>Black Bear</i> .
	{	Maritime.	{	SOLES OF THE	}	"
FEET COVERED				WITH HAIR.		

The *Grizzly Bear*, so called because of the intermixture in its fur of grayish hairs with black and brown, is the most ferocious of the North American carnivora. Its sharp, powerful claws, often five inches long, move independently of one another, and, when the animal strikes with its paws, cut like so many chisels. Its strength enables it to carry off a bison, and dig a pit in which to bury it.*

Black Bear.—While the *Grizzly Bear* is limited to the Rocky Mountain regions, the *Black Bear*, under a variety of names, is distributed over North America. An expert

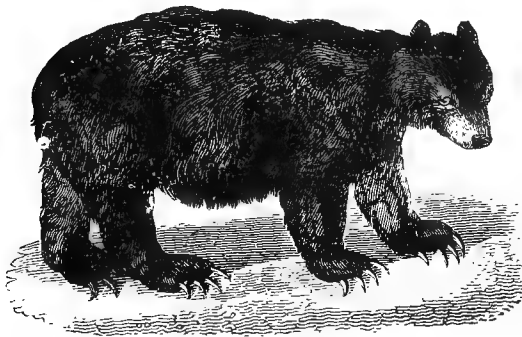
* Such is the terror inspired by this formidable beast, that no other animal will dare to touch a deer which it has killed and left behind; the simple print of the bear's foot frightening away even a hungry wolf. Its tail is very short and entirely hidden beneath its fur. The Indians sometimes amuse themselves with the perplexity of persons who are ignorant of this fact, by requesting them to lift the carcass of a *Grizzly* which they say is easily done if seized by the tail.—(Wood.)

Fig. 59.

*Ursus horribilis*, Grizzly Bear. $\frac{1}{5}$.

climber, honey is its favorite food; though its powerful claws are adapted to tearing up young shoots and succulent roots. Its mode of attack is to rear upon its back feet, and seizing its victim between its fore legs, either to suffocate it with its embrace, or disembowel it with its hind claws. In the colder

Fig. 60.

*Ursus americanus*, Black Bear. $\frac{1}{3}$.

latitudes it passes the winter usually in a hollow log, without becoming insensible.

Fig. 61.



Ursus maritimus. White Bear. 15.

The *Polar Bear** is the largest member of this family. It feeds on seals, fish, and walruses, which it pursues in the water, swimming and diving with great skill. To secure firm footing on the ice, the soles of the feet are thickly

covered with long hairs. It passes January and February in a lethargy, buried in the snow or hidden in the ice-rifts.

Procyonidæ.—The *Raccoon* is the only representative of its family in the United States. It derives its specific name from its habit of dipping its food in the water before eating. Though its entire foot is naked, yet in walking it does not, like the bear, bring its whole sole to the ground. Omnivorous in its food, it is, according to circumstances, a fisher, a hunter, a trapper, a reaper, or a fly-catcher, having the instinctive cunning of the fox, the inquisitive meddlesomeness

Fig. 62.



Procyon lotor, Raccoon, or Common "Coon." 16.

of the monkey, the greediness of the bear, and the slyness of the cat.

* Its sense of smell being exceedingly keen, several are frequently collected about a carcass. This fact has given rise to the idea that the Polar, unlike other Bears, is social in its nature. The ice-fields on which it lives are often detached and float off, carrying it to sea, where it has been descried by sailors a hundred miles from land.

Bassaridæ.—The *Civet Cat** is raccoon-like in appearance and habits, but differs in the length and size of its banded tail, and its more arboreal life. The California miners make it a domestic pet.

Fig. 68.

*Bassaritis astuta*, Civet Cat. $\frac{1}{2}$.

Otariidæ.† — The Eared Seals are principally found in the Pacific Ocean. The most remarkable species is the Northern *Sea Bear*,‡ so called from the striking resemblance of its head to that of the

Fig. 64.

*Callorhinus ursinus*, Sea Bear. $\frac{3}{4}$.

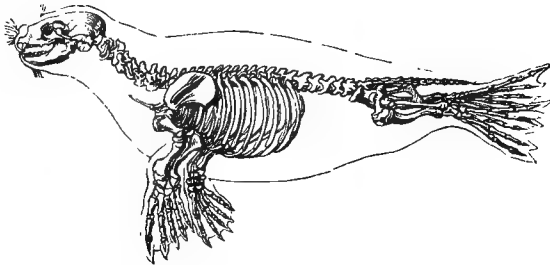
* The true Civets, Viverridæ, belong to the Old World, while the Civet Cat is found in the New.

† The three following families are grouped under the general name of *Pinnipeds* (fin-footed), or *Pinnigrades* (fin-walkers).

‡ The Sea Lion (*Eumetopias stelléri*) is a species of the Eared Seals with habits similar to those of the Sea Bear. Full-grown males are often thirteen feet long and weigh nearly a ton. In the harbor of San Francisco hundreds of these animals are seen, scrambling over the steep rocks, biting and pushing off their comrades, and rolling over one another, keeping up, meanwhile, a peculiar and incessant barking.

Ursidæ. It is polygamous, families of over a hundred, with one male chief, keeping entirely separate. Each dam, in returning from a fishing excursion, will pass by thousands of others lying along the shore and bleating like sheep, till it comes to its single cub. The Sea Bear furnishes the choicest seal fur.

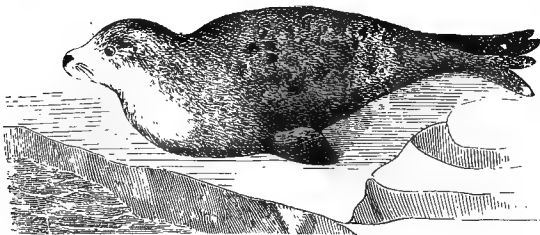
Fig. 65.



Skeleton of Seal.

Phocidæ.—The *Common Seal* abounds upon the Atlantic coast. The different species vary in length from three to twenty feet and present every variety of marking and color.

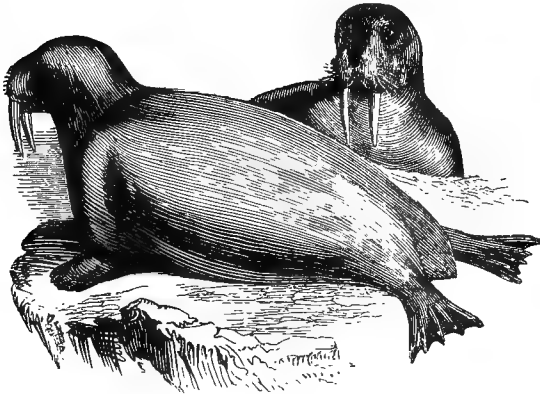
Fig. 66.

*Phoca vitulina*, Common Seal.

Their eyes are large and full of intelligence,* and the animal is easily tamed.

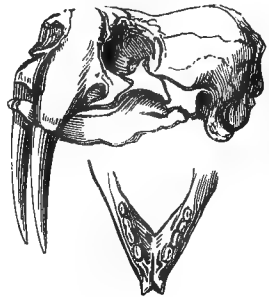
* Emerging unexpectedly from the depths of the sea, with dripping manes (which some species possess) and uttering a feminine scream, it is not strange that the imagination has mistaken them for human beings and given rise to the legends of

Fig. 67.

*Rosmārus obēsus*, Walrus. ♂.

Rosmaridæ.—The *Walrus*, unlike the seal, has neither lower incisors nor canines, while the upper canines project downward, sometimes two feet. By means of these and the vacuum-forming soles of its feet, it often ascends almost perpendicular icebergs a hundred feet high. It is omnivorous, feeding on shrimps, small fish, young seals, and marine vegetables, using its tusks for grubbing up the plants on the sea-bottom. The parental affection of the dams is great, and on the first alarm they take their cubs under their fins and escape to the water.*

Fig. 68.



Canine Teeth and Underjaw of Walrus.

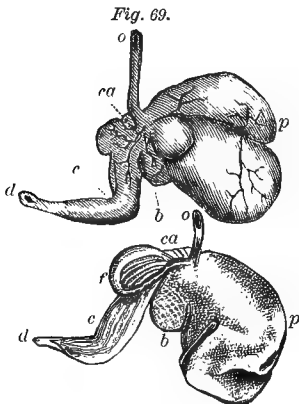
tritons, sirens, sea-nymphs, and mermaids. All the Phocidæ have the singular habit of swallowing stones, as many as four pounds of sharp pebbles having been found in a single stomach, but no satisfactory explanation of this phenomenon has been given.

* The Seal and the Walrus are the subsistence of the inhabitants of the Arctic regions. The flesh furnishes food; the fat, light and fuel; the lining of the intestines, windows for their snow-huts; the skin, clothes, thongs and boats; the tendons supply thread and bow-strings; and the teeth, hunting implements.

ORDER UNGULATA.

General Characteristics.—The distinguishing feature of this extensive order is that the toe-nails form hoofs. The Families differ in almost every other respect.*

Ruminant Digestion.—The food of Ruminants consists of vegetable matter, little nutritious, and hence demanded in large quantities. As they are in turn the food of carnivorous animals, and their only safety lies in flight, while mastication is a work of time, they fill a large stomach-reservoir by rapid grazing, re-chewing its contents in a place of security. The stomach is divided into four compartments.



Stomach of a Ruminant.

The food passes without mastication into the *rumen* (*p*), next into the *reticulum* (*b*), thence back through the oesophagus (*o*) to the mouth, where it is masticated; then down the oesophagus a second time into the *leaflet* (*f*), and thence into the *caillette* (*c*) or true stomach. The mechanism by which the food goes through the same orifice at the bottom of the oesophagus, at one time into the rumen and at another into the leaflet, may well create surprise. The oesophagus is

continued below in a tube (*ca*), with a slit on the under side whose lip-like edges shut water-tight, forming a passage from the oesophagus to the leaflet. If, however, the mouthful of food swallowed be large and solid, as it is when first eaten, it distends the tube, and, separating the edges of the slit, falls into the first stomach; but if it be soft and pulpy, as it is after being re-chewed, it does not force apart the edges

* Those having the number of toes even are styled *Artiodactyls*, and odd, *Perisso dactyls*. The Artiodactyls that chew the cud are termed *Ruminants*.

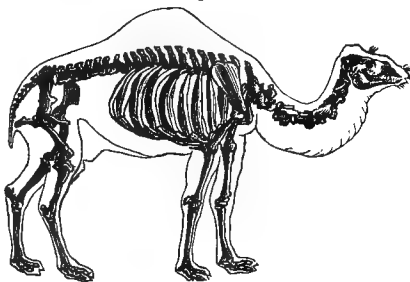
of the slit, and so reaches the third stomach. Here it undergoes further preparation and passes directly into the fourth stomach, where the actual process of digestion is carried on. The mechanism for conveying the unchewed mass in the first stomach back into the mouth also depends upon the lip-like tube. The contraction of the walls of the rumen forces portions of the food into the reticulum; in turn, the contraction of its walls crowds a part against the outside of the lips, which, opening, pinch off a portion, and, compressing it into a ball, present it to the œsophagus, the fibres of which, contracting successively from below upward, push it forward into the mouth.

The order can be tabulated into Families by a comparison of their hoofs and horns:

UNGULATA.	Artiodactyl;	TWO TOES.	RUMINANTS	WITHOUT HORNS;	Camelidæ,	Camel.
				WITH HORNS, (WITH ONE EXCEPTION.)	Persistent: {	Giraffidæ,
				covered, {	Bovidæ,	Ox, etc.
				Deciduous: {	Antilocapridæ,	Prong-horn.
				Of solid bone.	Cervidæ,	Deer, etc.
	Perissodactyl;	FOUR TOES;			Hippopotamidæ,	Hippopotamus.
			Suidæ,	Hog.		
			Dicotylidæ,	Peccary.		
		ONE TOE;			Equidæ,	Horse, etc.
		THREE TOES;			Rhinocerotidæ,	Rhinoceros.
					Tapiridæ,	Tapir.

Camelidæ.—Camels have two toes, united nearly to the point by the callous sole. The second stomach is used as a receptacle for water, the excess overflowing into cells along the upper part of the first stomach, which the animal can open at will, and supply the moisture necessary for digestion.

Fig. 70.



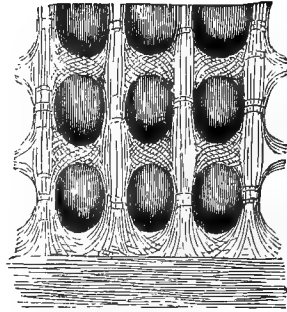
Skeleton of a Camel.

Fig. 71.



Foot of a Camel.

Fig. 72.

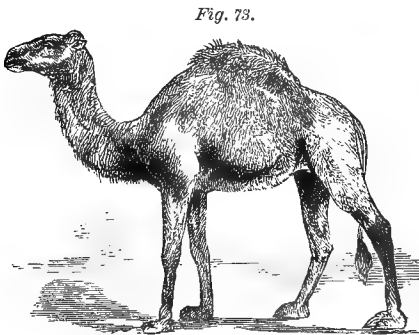


Water-cells of Camel's Stomach.

The Family is tabulated as follows :

CAMELIDÆ.	{	Toes united to the nail.	} ONE HUMP ;	Camelus dromedarius,	<i>D. omedary.</i>
			} TWO HUMPS ;	Camelus bactrianus,	<i>Bactrian Camel.</i>
	{	Toes separated.	} WITHOUT HUMP ;	Auchenia llama,	<i>Llama.</i>

The *Dromedary* is peculiarly adapted to sterile regions. Its long neck, incisors and canines in both jaws, prehensile,



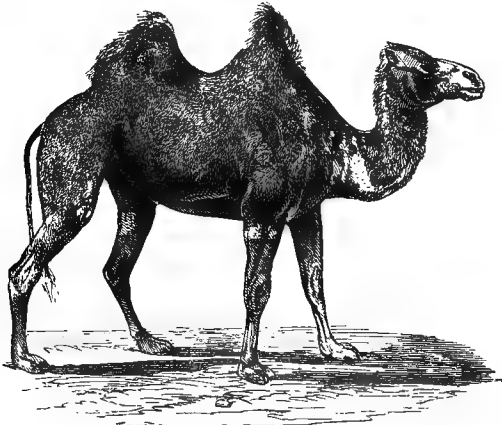
Camelus dromedarius, Dromedary. 175.

cleft upper lip, and narrow cheek-bones, enable it to crop its food of thorny bushes by the way-side without retarding its speed; its hairy nostrils, which close intuitively, protect it from inhaling the particles driven by the si-moom: its broad, cushioned foot prevents its sinking in the sand; its many-

its many-

celled stomach enables it to go a week without drink, and the gradual absorption of its fatty hump as long without food; its callosities on the breast and joints permit its kneeling to receive its load; its projecting eye, sheltered from the sun by a double lid and a bony arch, and with the sight habitually directed to the path, gives sure-footedness.*

Fig. 74.

*Camēlus bactriānus*, Bactrian Camel. $\frac{1}{30}$.

The *Bactrian Camel* has two humps, and is adapted to cold climates, as the dromedary is to hot.

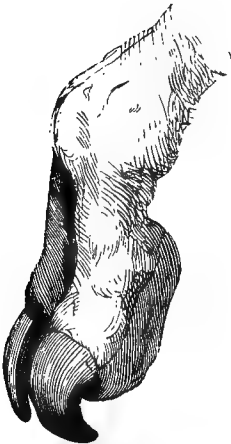
* The camel, poetically called by the Arab the "ship of the desert," constitutes his wealth. Its milk, and often its flesh, furnishes him food; its skin, leather; its hair, clothing; its excrement, fuel; and, in an extremity, the water in its stomach will save his life. It will carry 600 and even 1000 lbs. burden. A swift dromedary will travel 10 miles per hour for 20 hours on a stretch. Its gait has a peculiar swinging, jerking motion that is terribly trying to the novice. Its disposition is said to be naturally gentle, but the brutality of its drivers often renders it ugly. Thus says a traveler: Watch it when it is being loaded. See its keeper struggling frantically, and making it kneel only by sheer force, and when down, keeping it there by tying neck and fore legs together tightly. Hear it grumbling in deep, bubbling tones, with mouth savagely opened as each new burden is laid on its back. Look how it refuses to rise until a part is removed; then see it get up—a great, brown mountain, still groaning and bubbling—and dash to and fro, shaking off beds, furniture, and trunks in a shower. Mark it, subdued by blows, march through the day, occasionally biting at a passer-by, and at night kneel to have its load removed, grumbling as ever. Certainly not the picture of our ideal patient animal!

Fig. 75.

*Auchenia llama*, Llama. 3/5.

The *Llama*, the camel of the New World, is of small size, and has no humps. To adapt it to its home in the Andes, its cushioned toes are completely divided, and its nails project so as to hook downward, and give it a fearless step among the crags.

Fig. 76.



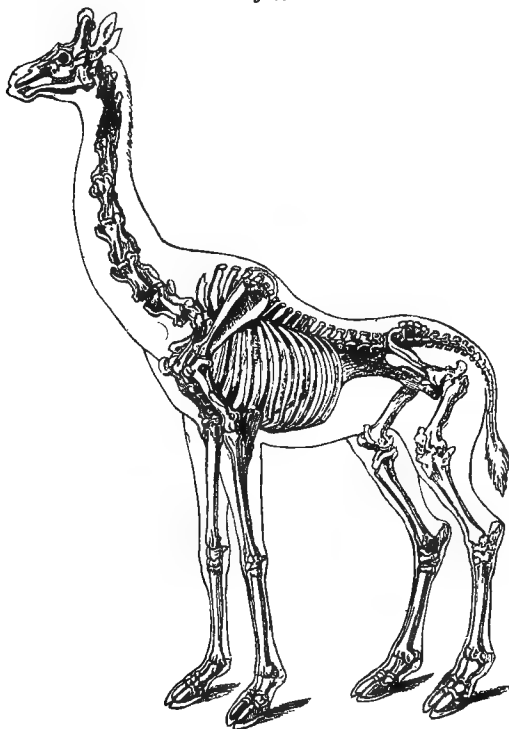
Foot of Llama.

Giraffidæ.—The *Giraffe*, inhabiting the arid regions of Africa, where herbage quickly disappears after the rainy season, is adapted by its long neck* to browse upon the branches of trees. There is an apparent difference in the length of the fore and hind legs; but the heads of the humerus and femur are on a level, and the great height of the fore-shoulder is caused

* Seven—the typical number of cervical vertebræ for all mammals—is not, however, varied from.

by the length of the scapula and the spinous processes. As its greatest enemy is the low-crouching lion, that usually springs upon its prey from behind, its eye is so placed on the side of the head, that it can see backward as well as forward;

Fig. 77.



Skeleton of a Giraffe.

and, as the danger is from below, while its food is above, the sensitive tufts on the tips of its skin-covered horns indicate, as it stalks among the trees, the presence of leaves overhead. It uses its short horns for defence by a sidelong sweep of the neck rather than by butting. Its chief reliance, however, is on rapid and powerful kicks—sufficient to break the skull of

Fig. 78.

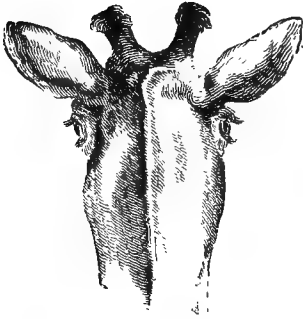
*Eyes of a Giraffe.*

Fig. 80.

*Tongue of a Giraffe.*

Fig. 79.

*Camelopardãlis giraffa, Giraffe.* 65.

a lion. The long tongue is prehensile, and so flexible as to be flattened and rounded like a plate, or contracted to enter a quill. In mimicry it resembles the branchless trunks among which it stalks and upon whose umbrella tops it feeds.*

Bovidæ.—The Ox family comprises ruminants having horns and cloven feet. It may be tabulated according to the structure of the horns.

* "In the case of the Giraffe, which is invariably met among venerable forests, where innumerable blasted and weather-beaten trunks occur, I have repeatedly been in doubt as to its presence, until I had recourse to my spy-glass; and on referring the case to my savage attendants I have known even their optics to fail, at one time mistaking these dilapidated trunks for camelopards, and again confounding real camelopards with these aged veterans of the forest."—*Cumming's Adventures.*

BOVIDÆ.	Bony axis of Horns with cells, which communicate through the frontal sinus with the nose. Horns curve	OUTWARD, DOWNWARD, THEN UPWARD.	} <i>Ovibos moschatus</i> , <i>Musk Ox.</i>
		TO THE SIDE, THEN UPWARD OR FORWARD, IN A CRESCENT.	} <i>Bos taurus</i> , <i>Domestic Ox.</i> <i>Bos americanus</i> , <i>Bison.</i> <i>Bos bubalus</i> , <i>Buffalo.</i> <i>Bos grunniens</i> , <i>Yak.</i> <i>Bos indicus</i> , <i>Zebu.</i>
	Bony axis of Horns without cells or pores. Horns curve	DIVERSIFORM.	} <i>Aplocerus montanus</i> , <i>Mountain Goat.</i> <i>Antilope rupicapra</i> , <i>Chamois.</i> <i>Antilope dorcas</i> , <i>Gazelle.</i> <i>Antilope kudu</i> , <i>Koodoo.</i> <i>Antilope gnu</i> , <i>Gnu.</i> <i>Antilope oryx</i> , <i>Gemabok.</i>
		UPWARD AND BACKWARD: FOREHEAD CONCAVE.	} <i>Capra saggurus</i> , <i>Goat.</i> <i>Capra ibex</i> , <i>Ibex.</i>
		BACKWARD THEN SPIRALLY FORWARD; FOREHEAD CONVEX.	} <i>Ovis montana</i> , <i>Mountain Sheep.</i> <i>Ovis aries</i> , <i>Domestic Sheep.</i>

The *Musk Ox*, so called from the flavor of its flesh, inhabits Arctic North America.* It feeds on grass and lichens. The horns widen at the base, so as entirely to cover the crown of the head.

Difference between Herbivora and Carnivora.†
—A distinguishing

feature of the Ruminants is the elevation of the heel, which compels the animal to walk upon its nails (the Camelidæ excepted). The Carnivora bring the entire toes to the ground,



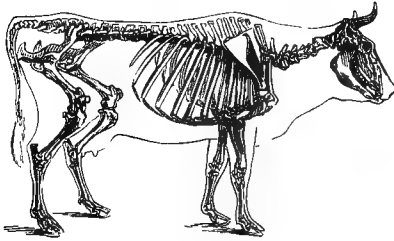
Ovibos moschatus, Musk Ox. $\frac{1}{2}$.

* The Esquimaux hunters will attack this irritable animal with only a knife, and turning around quicker than it can wheel, stab it to death.

† A comparison of Figs. 27, 65, 77, 82, will show that the differences in the various parts of the skeleton are those of relative size and adaptation rather than of number.

and being thus unable to outrun their victims, pounce upon them from concealment. The Carnivora have incisors, canines, and molars, but many of the Herbivora lack upper incisors, and all, true canines, while the surfaces of the molars are no longer trenchant, but ridged either longitudinally or transversely.

Fig. 82.



Skeleton of a Cow.

Fig. 83.

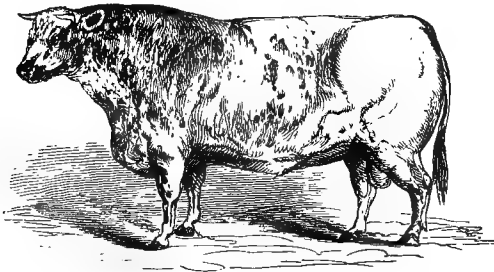


Teeth of Herbivora.

The *Domestic Ox* evinces no trace of its origin or that of its numerous varieties. Endowed by the Creator with inherent qualities adapting the genus to easy acclimation, it is everywhere found the

companion of civilized man. There are in this country three noted breeds, each distinguished for peculiar excellencies.*

Fig. 84.

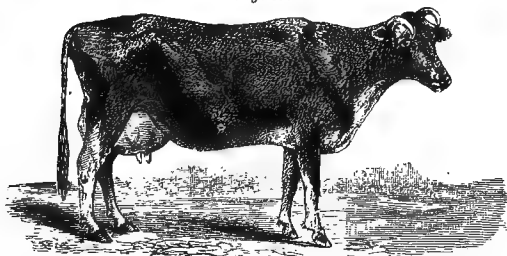


Short Horn.

The Short Horn, or Durham, from Durham county, England,

* A careful study of Figs. 84, 85 and 86 will clearly define the points of distinction in these varieties, and enable the student to identify each in a herd or at a Fair.

Fig. 85.

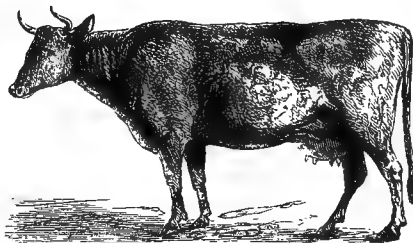


Jersey.

is pre-eminent for beef. The Jersey, from the island of Jersey, is unrivaled for the quality, and the Ayrshire, from Ayrshire, Scotland, for the quantity of its milk.

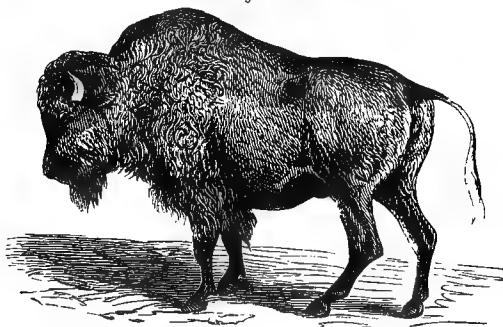
The *Bison* is the only bovine, except the Musk Ox, indigenous to America.* Originally ranging in

Fig. 86.



Ayrshire.

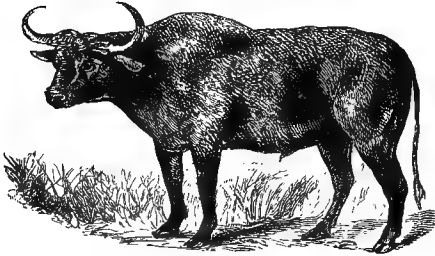
Fig. 87.

*Bos americanus*, Bison. $\frac{1}{10}$.

* Having the distinctive hump on the fore-shoulders, it is a true Bison and not a Buffalo, as it is generally called.

immense herds over the most of the United States, it is now found only on the great plain between the Mississippi and the Rocky Mountains and is fast becoming extinct. The old males sometimes weigh a ton, and though so cumbrous

Fig. 88.

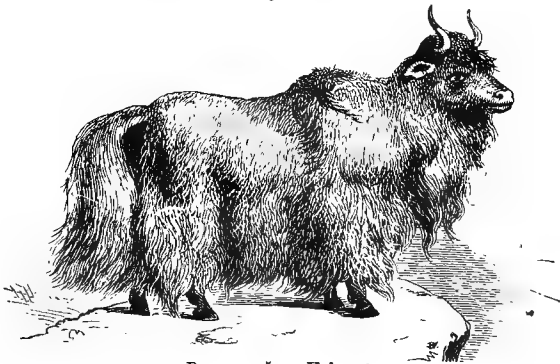
*Bos bubalus*, Buffalo.

in appearance, are very swift. Their horns are used for defence, and for tearing uproots and furrowing the snow in search of food.

The *Buffalo* inhabits the southern part of Asia, and is distinguished by its

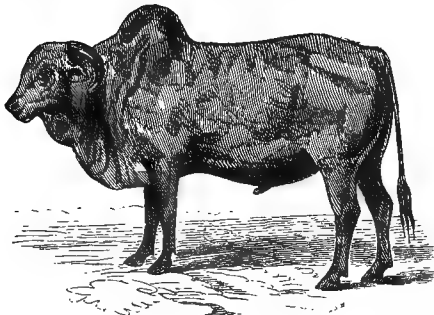
enormous horns. Their bases are of great strength, while their length exceeds four feet, with tips five feet apart. In order to use even the tamest Buffalo, a ring is put in its nose. The traveler over the Campagna of Rome often sees these wild-looking animals employed in agricultural labor.

Fig. 89.

*Bos grunniens*, Yak. $\frac{1}{5}$.

The *Yak*, or grunting ox, is found both wild and domesticated in Central Asia. Its characteristics are so modified by subjugation as to produce many tame varieties.

Fig. 90.

*Bos indicus*, Zebu. $\frac{1}{16}$.

The *Zebu* is the beast of burden for the eastern coast of Africa, the Indian Archipelago, and Southern Asia.*

The *Mountain Goat* is found on the higher slopes of the Rocky Mountains. It has small, jet black, ringed horns, and long white hair.

Fig. 91.

*Aplocærus montānus*, Mountain Goat.

The *Chamois* inhabits the Alps, living in small flocks upon the giddy heights where the eye can hardly detect a standing-place. Springing diagonally down an almost perpendicular rock and striking the face of the cliff three or four times with its feet, it will land securely at the desired point.† At a suspicious sound

a flock will stand for an incredible time as quiet and fixed, apparently, as the rocks around them. A sentinel is always posted to give the signal of danger.

* It is not a bison though it has the distinctive hump, for the bison's consists of muscles that move the head, while the hump of the Zebu is composed of fat.

† Though chamois-hunting among the Alpine fastnesses is attended with great peril, so that in one instance father, son, and grandson successively perished in the pursuit, yet the occupation is so fascinating as to be rarely relinquished.

Fig. 92.

*Antilope rupicapra*, Chamois. $\frac{1}{3}$.

Fig. 93.

*A. dorcas*, Gazelle. $\frac{1}{3}$.

The *Gazelle* has an elegant form ; black, round, and thick horns ; large, dark, and lustrous eyes ;* and a swiftness so great that the greyhound cannot overtake it.

Fig. 94.

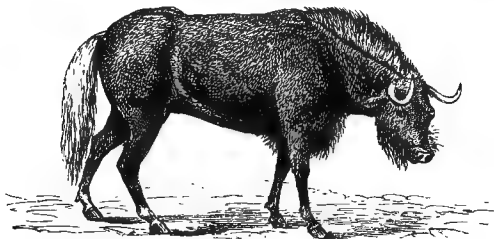
*A. kudu*, Koodoo. $\frac{1}{3}$.

The *Koodoo* is characterized by its curiously twisted horns. It inhabits South Africa, and is exceedingly handsome and graceful.

* These are so proverbially beautiful as to give rise to the expression "gazelle-eyed." (See Moore's *Lalla Rookh*—The Fire-Worshippers.)

The *Gnu* resembles the horse, buffalo, and deer. It is, however, a bovine antelope.*

Fig. 95.

A. gnu, Gnu. $\frac{3}{5}$.

The *Oryx*, or Gemsbok, is sometimes called the Unicorn, as its straight horns, seen in profile, so exactly cover each other as to seem but one. It is the only antelope that defends itself against the lion; receiving its enemy on the point of its sharp horns, which serve as natural bayonets.

The *Goat*, notwithstanding its diversity in form, color, shape of horns, and in fineness of hair—which in some species approximates wool—possesses characteristics bringing it into the unity of a genus. It is an indiscriminate feeder, thriving upon many plants that are poisonous to other ruminants, and

Fig. 96.

A. oryx, Gemsbok. $\frac{3}{5}$.

* Gnus live in herds, often mixing with ostriches, zebras, and giraffes in one great mass. When alarmed they spring up, and whisking their long white tails, pursue one another at full speed, pawing, kicking, and the bulls fighting and tumbling down at every shock. This strange conduct has given them the name of Wildebeeste among the Dutch settlers. Gnus are so timid that at the first sight of a strange object they will set off as if half-crazy with fear, but their curiosity soon leads them to return to inspect it, though at the risk of their lives. A hunter, by merely tying a red handkerchief to the muzzle of his gun, has thus enticed a herd within musket range. He must look out, however, lest they charge down upon him so savagely as in turn to put him to flight.—(Wood.)

thus serves in the great creative scheme to diminish weeds that would become excessive in grazing districts.* It is the

Fig. 97.



Capra aegagrus, Goat. $\frac{1}{10}$.

cow of the European peasantry, a pair often yielding half the support of a family.

The *Ibex* differs from the Goat in having longer and recurved horns, with two longitudinal ridges instead of one, and their transverse markings knotted. The Goat inhabits

Fig. 98.



Capra ibex, Ibex. $\frac{1}{10}$.

* It prefers steep and solitary places, leaping singly, or even when two are tied together, across frightful chasms, and always alighting in concert at the desired spot. If two meet in a narrow path, one will lie down and the other walk over its back.—Cashmere shawls, kid gloves, morocco leather, goat's-hair wigs, and rock venison are luxuries derived from these humble but useful animals.

the lower stage of mountain slopes, the Chamois the middle, and the Ibex the highest.*

The *Mountain Sheep*, found wild on the Rocky Mountain slopes, differs from the Ibex in having a convex forehead, horns directed backward, then spirally forward, and two kinds of hair, one being crimped. It feeds on grassy knolls

Fig. 99.



Ovis montana, Mountain Sheep. $\frac{1}{4}$.

surrounded by craggy rocks, to which it retreats when attacked by wolves. Its horns sometimes grow so long and curve so far forward and downward that it cannot graze on level ground.

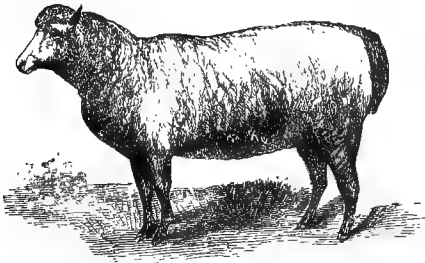
The *Domestic Sheep* exhibits no less than forty well-marked varieties, and yet so shading into one another that all have doubtless originated from a common stock.† Its sharp,

* The story of the Ibex throwing itself from lofty precipices and landing upon its horns is considered a myth, though often reported by the earlier Naturalists.

† The influence of climate is remarkably shown in the tendency of the Merino breed to develop an additional pair of horns when transferred from Spain to Peru. A breed found in Syria have tails weighing from seventy-five to a hundred pounds,

chisel-like incisors and cleft upper lip enable it to bite closer than the Ox, and thus procure sustenance where that animal

Fig. 100.

*Ovis aries*, Sheep.

would starve. The Goat, in defending itself, rears upon its hind legs, and comes down head first upon its opponent with the weight of its body; the Sheep runs forward and butts with the combined force of its weight and impetus.

Antilocapridæ.—The *Prong-horn Antelope* is allied both to the Antelope and the Goat. Like the former, its horns contain an osseous core, but unlike it they are deciduous, and have a prong about midway. The hair on the body stands out straight, and, being hollow like a bird's feather, when bent will not resume its form.

Fig. 101.

*Antilocapra americana*, Prong-horn. $\frac{1}{2}$.

Cervidæ.—The Deer Family have solid, deciduous horns, which are cast annually, and at each renewal grow larger and more branching. Two cartilaginous prominences first appear on the forehead. These ossify and form the horns, which are still covered with velvety skin. Soon a ring of bone

which the shepherds support with a board set on wheels. In Angola is a variety called the goitred sheep from its having two lobes of fat beneath the throat, which, like the hump of the Dromedary, serve it for food during the dry season.

gathers around the base of each horn, with passages for the arteries. These openings narrow, and gradually shut off the blood, that it may not by a sudden stoppage rush to the brain and produce apoplexy. The velvet, now deprived of its nourishment, soon withers and is rubbed off, leaving the white horn beneath. The Family is classified into Genera by the conformation of the antlers:

CERVIDÆ.	{	Horns developed ;	{	PALMATED,	{	BROADLY.	Alces malchis,	<i>Moose.</i>
				AT TIPS.	{	Rangifer tarandus,	<i>Reindeer.</i>	
		CONICAL;	BENDING BACKWARD.	{	Cervus canadensis,	<i>Wapiti.</i>		
			BENDING FORWARD.	{	Cervus capreolus,	<i>Roebuck.</i>		
			PRONGS PARTLY UNITED.	{	Cervus virginianus,	<i>Deer.</i>		
Horns not developed ;				{	Cervus dama,	<i>Fallow Deer.</i>		
					Moschus moschiferus,	<i>Musk Deer.</i>		

The *Moose*, once abundant in the northern parts of North America, is now becoming extinct. Its broad, palmated

Fig. 102.



Alces malchis, Moose. 1/16.

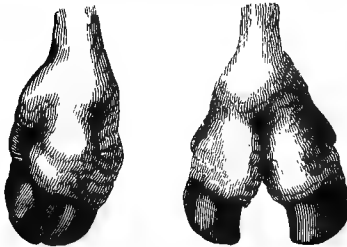
horns, weighing fifty to sixty pounds, are used in bending down boughs and ploughing up the snow. For defence, it relies upon rapid blows with its fore feet—a stroke of which will kill a wolf. Its pace is a quick trot, the feet being lifted so as to pass over a fence five feet high without apparent change of step.

The *Reindeer** has widely-spreading hoofs, as a special provision for traveling on the snow; while to give a secure hold

Fig. 103.

*Rangifer tarandus*, Reindeer. $\frac{1}{18}$.

Fig. 104.



Hoof of Reindeer, closed and open.

upon the crags, the toes of the closed foot are firm and pointed. In summer, it subsists upon Arctic shrubs, and in winter upon moss, which it detects under the snow by its keen smell, and digs up with the palmated tips of its antlers.†

The *Wapiti*, or American Elk, identical with the red deer or stag of Northern Europe, has long, branching, conical horns, sometimes six feet apart at the tips.

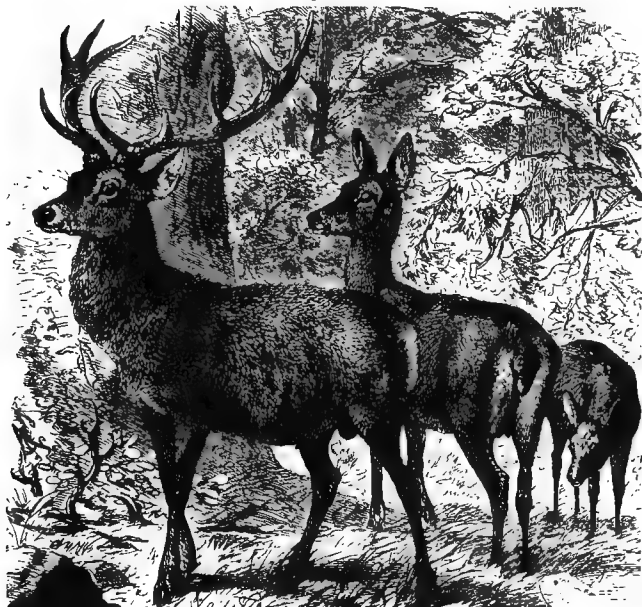
The *Roebuck*, marked by its white haunches, is the smallest of the British deer. Its short, straight

horns are divided into three branches. Unlike other deer, it pairs for life, and lives in families.

* The Caribou of North America is now considered identical with the Reindeer of Lapland, and, if domesticated, would doubtless, in a few generations, show as many varieties.

† Harnessed to a sledge, with only a collar and a trace passing between its legs, and guided by a single rein attached to its neck, the Reindeer easily draws its master over the snow a hundred miles a day. It has been known to run nearly 19 miles in an hour and 150 in 19 hours. To the Laplander, it is at once horse, cow, and sheep. Its horns supply tools; its hide and hair, clothing; and its flesh and milk, food. Without it Lapland would be uninhabitable. The inhabitants reckon their wealth by their reindeer, as the Arabs do by their camels. A rich Laplander owns one thousand or more.

Fig. 105.



Cervus canadensis, Wapiti. 40.

Fig. 106.



Cervus capreolus, Roebuck. 1/4.

The *Virginia Deer* is common in the United States. It differs in size according to locality, the Southern specimens being smaller.* Its antlers bend

Fig. 107.

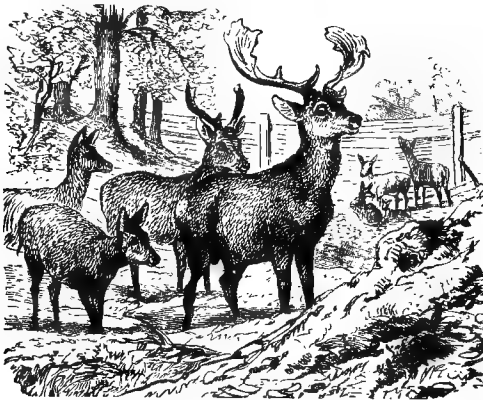


Cervus virginianus, Virginia deer. $\frac{3}{5}$.

forward, with varying prongs. The males while fighting sometimes interlock their antlers, and, unable to release themselves, perish miserably. The spotted young are called Fawns, and may be easily domesticated. The sagacity of the deer is shown in taking to the water when hunted with dogs, its greater height giving it a footing, while they, compelled to swim, are comparatively helpless.

The *Fallow Deer*, so called from its tawny brown color, is the domesticated species of the English parks. A large buck takes the lead of the herd, and suffers none but a few favorites to approach his regal presence.

Fig. 108.

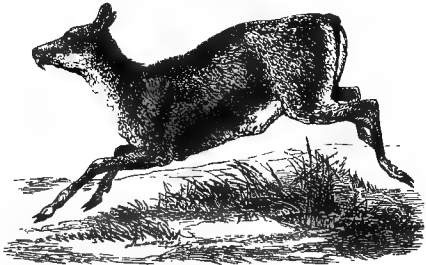


Cervus dama, Fallow deer. $\frac{3}{5}$.

* The deer is a great destroyer of rattlesnakes, cutting them to pieces by alighting upon them with all four feet.—Its skin is tanned by the Indians by pounding in a solution of its own brains, and is known as "buck-skin."

The *Musk Deer* of Thibet has no horns, the male having two sharp projecting upper canines. It furnishes the musk of commerce, which it secretes in a kind of pouch.

Fig. 109.

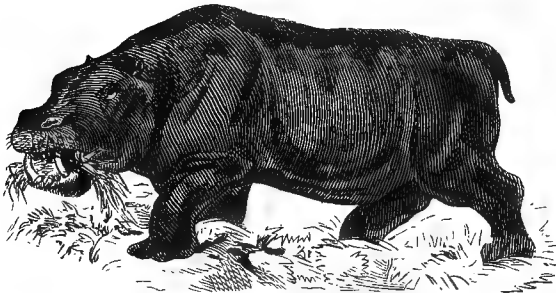
*Moschus moschiferus*, Musk deer. $\frac{1}{4}$.

Hippopotamidæ.

The *Hippopotamus* of Africa is amphibious, with horizontally-projecting lower incisors and strong vertical canines.

A greedy feeder, it sinks to the bed of the sluggish stream, where it can remain six or eight minutes, digs up a quantity of aquatic vegetation, rises to the top, and, washing

Fig. 110.

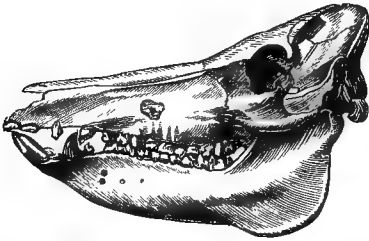
*Hippopotamus amphibius*, Hippopotamus. $\frac{1}{6}$.

the mass, devours it while leisurely floating on the surface. It is exactly fitted to dredge the rivers and keep open the channels, so apt to become filled with the luxuriant growth of that tropical region.

Suidæ.—The Hog's skull is adapted to rooting in the ground for food, the lower canines projecting nearly horizon-

tally, and by friction upon the upper being sharpened so as to constitute formidable weapons.

Fig. 111.



Skull of Hog.

the eyes in rushing through the bushes.

The *Peccary* of the New World represents the Wild Boar of the Old. There are but two species, the collared and the white-lipped—the former living in families,* and the latter in

Fig. 112.



Sus scrofa, Wild Boar. $\frac{3}{4}$.

* The whole company of twenty or more are accustomed to back singly into a hollow log to sleep, the last one acting as a sentinel. This one being shot, the

Fig. 113.

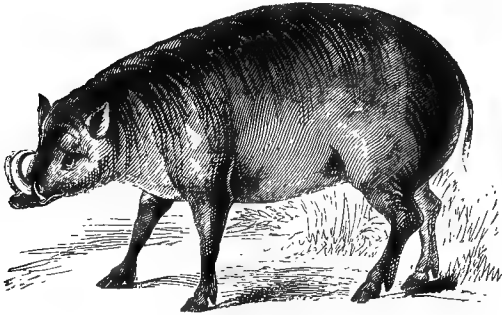
*Sus babiroussa*, Babiroussa Hog. $\frac{1}{15}$.

Fig. 114.

herds which stretch out for miles in their destructive migrations. They resemble pigs, but have slender tusks capable of inflicting terrible wounds.

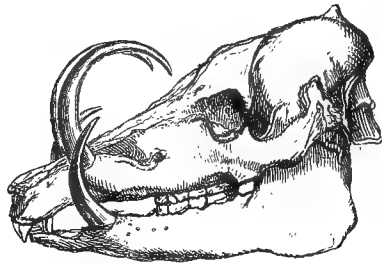
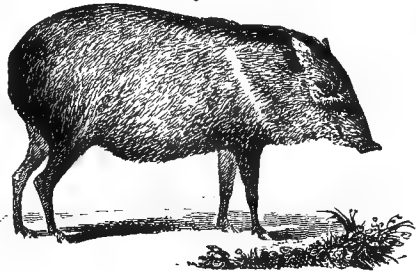
Skull of Babiroussa. $\frac{1}{15}$.

Fig. 115.

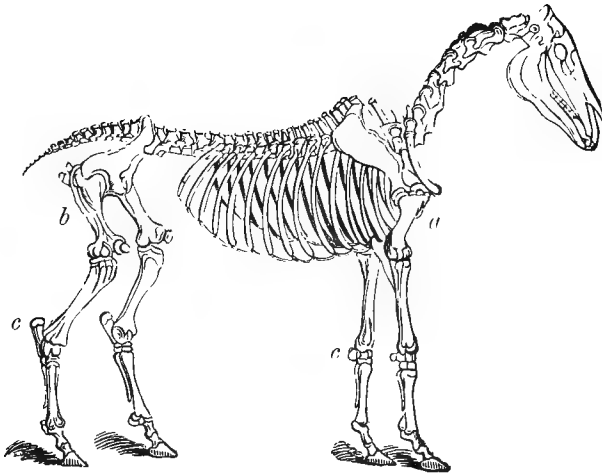
Equidæ. — The Horse family have a single hoof* to each foot, with metacarpals elongated so as to compel them to carry the heel (c) high up from the ground. Strictly herbivorous with upper and lower incisors, they seem designed to crop after the

*Dicotyles torquatus*, Peccary. $\frac{1}{18}$.

others successively take its place, so that, if skillfully managed by the hunter, the whole number may be captured.

* The earlier fossil species had five, later ones four, and still later three toes, the indications of two suppressed, called splint bones, being still seen.

Fig. 116.



Skeleton of Horse

ox, and in their turn to be followed by the narrow-jawed sheep with the cleft upper lip, enabling it to nibble where neither of the others could thrust its wide mouth.

Fig. 117.

*Equus caballus*, Horse.

The *Horse* has been so diversified by domestication as to defy all attempts to trace its origin.* It is adapted to constant movement by having a simple stomach without a gall bladder which

* Careful research proves that there is not a distinctive Arabian breed—often-times considered the parent of the horse—any more than there is a Persian or an English one.

permits uninterrupted digestion. Changing its coat of hair to suit the season, it is easily acclimated; in tropical regions the hair remaining short and sparse, in colder, lengthening to three or four inches and thickening so as to become almost woolly.

The *Ass* is generally employed by the peasantry throughout the East.

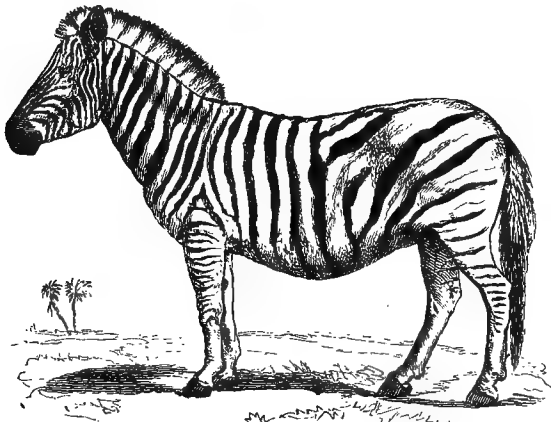
Feeding upon coarser herbage than the horse, and being more patient under abuse, it is better adapted to be the slave of the poor.*

The *Zebra* is the most elegant of quadrupeds, but all attempts to domesticate it have failed.

Fig. 118.

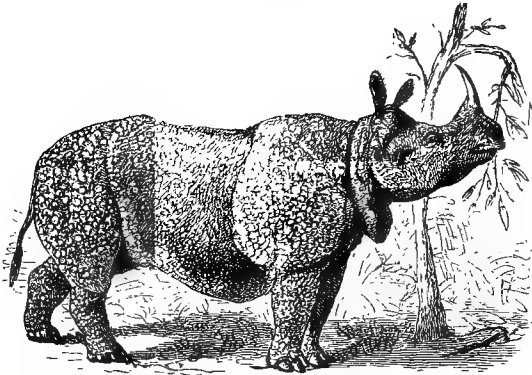
*Equus asinus*, Wild Ass. 35.

Fig. 119.

*Equus zebra*. 35.

* It is common in European cities to see these animals driven every morning to the door of the sick to be milked for their use.

Fig. 120.

*Rhinoceros unicornis*, One-horned Rhinoceros, India. $\frac{1}{2}$.

Rhinocerotidæ.*—The *Rhinoceros*, paradoxical as it may seem, possesses a skeleton more nearly allied to the horse than any other hoofed quadruped. It has a

Fig. 121.

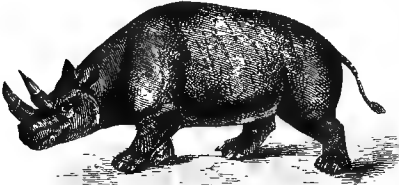
*Rhinoceros bicornis*, Two-horned Rhinoceros. Africa. $\frac{1}{5}$.

Fig. 122.

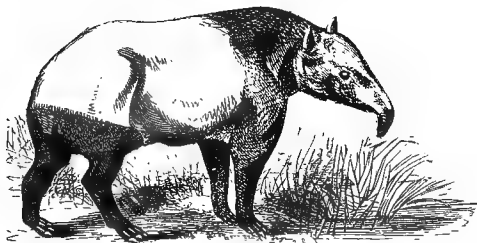
*Hyrax syriacus*, Daman. $\frac{1}{2}$.

hard, naked, rough skin, laid in large folds, and so elastic that a bullet or spear-hole immediately closes, thus stanching the wound. The horn is composed of agglutinated hairs, and, being attached

* Closely allied to the rhinoceros in structure is the Hyrax, the only genus of the order Hyracoidea. The Daman, in its various species, is a rabbit-like animal found in Syria, Mozambique, and Southern Africa. A timid creature, it hides itself in the clefts of the rocks, and is, doubtless, the Coney of Scripture (Proverbs xxx, 26).

only to the skin, is movable; when, however, the animal is enraged, it becomes fixed as though a part of the bone itself. Individuals attain the weight of 6000 pounds.

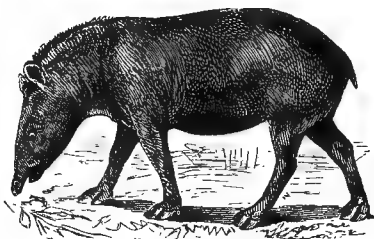
Fig. 123.



Tapirus bicolor, Indian Archipelago. ♂.

Tapiridæ.—The *Tapir* links the artiodactyls and perissodactyls, its fore feet having four toes and its hind feet three. Flight being its only means of defence, the head, covered with hard skin and shaped like a conical wedge, is adapted for boring through tangled brushwood. The uniform black color of the South American Tapir is in striking contrast to the white back of the Indian.

Fig. 124.



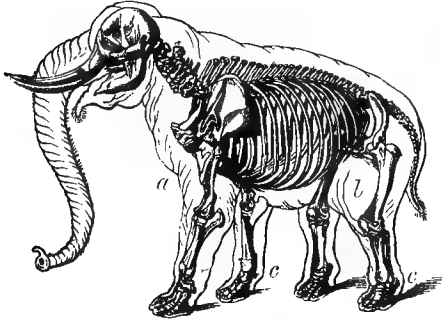
Tapirus americanus. ♂.

ORDER PROBOSCIDEA.

Elephantidæ.—The *Elephant* is the largest of living quadrupeds, attaining eight to ten feet in height and 10,000 pounds in weight. It roams the forest in herds of twenty or more, and is supposed to live over one hundred years. Un-

like the Horse, it has the metacarpal bones shortened, so that the

Fig. 125.



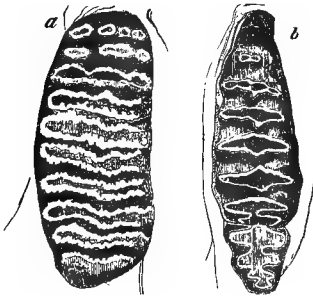
Skeleton of Elephant.

heel (c) is brought near the ground. The two upper incisors are prolonged into tusks, which serve for defence and for ploughing up the ground to obtain succulent roots. The nose is lengthened into a proboscis or trunk containing several thousand muscles, which permit every conceivable motion; while a mobile lip at the end is delicate enough to pick up a grain of wheat. This enables the Elephant to reach its food, which it could not do with its mouth, on

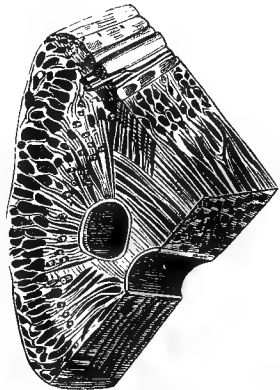
account of its short neck and huge tusks. Water is also drawn into the trunk by suction, and then, the end being inserted into the mouth, discharged down the throat. The

Fig. 127.

Fig. 126.



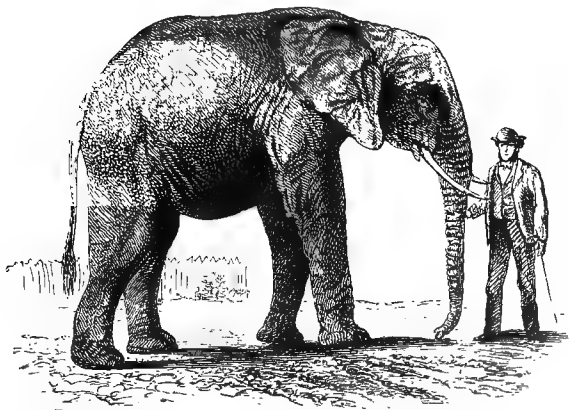
a. Tooth of Asiatic Elephant.
b. Tooth of African Elephant.



Section of Elephant's trunk.

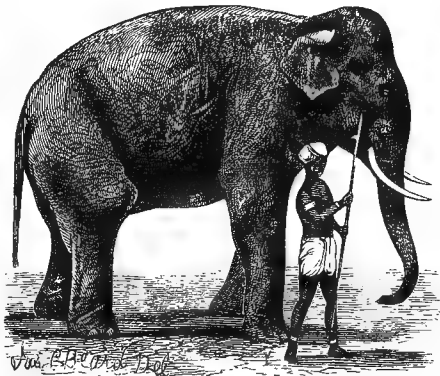
account of its short neck and huge tusks. Water is also drawn into the trunk by suction, and then, the end being inserted into the mouth, discharged down the throat. The

Fig. 128.

*Elëphas africānus*, African Elephant.

Asiatic species is alone tamed at the present day.* It has a concave forehead, small ears, and the enamel of the teeth arranged in transverse bands. The *African* species has a convex forehead, enormous ears, and the enamel of the teeth lozenge-shaped. Both sexes have tusks, the male's often being eight feet long and weighing a hundred pounds.

Fig. 129.

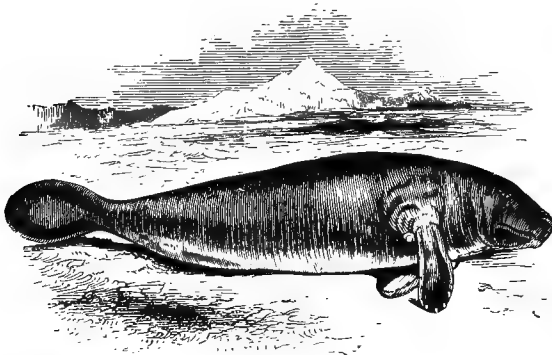
*E. indicus*, Asiatic Elephant.

* Its intelligence is sometimes almost human. It can be taught to lay stone wall, and to pile logs uniformly, rolling them up an inclined plane. It is even entrusted with the care of young children—the huge nurse being lavish in its attentions, and when its charge crawls between its legs, moving with the utmost caution, and, with its trunk, carefully lifting the child out of the way. Tennant, in his work on Ceylon

ORDER SIRENIA.

Trichechidæ.—The *Manatee*, or Sea Cow of the Florida coast, has, like the elephant, a short neck, dense bones, and the nostril in the end of the snout. It has no hind limbs,

Fig. 130.

*Trichechus manatus*, Manatee. $\frac{7}{10}$.

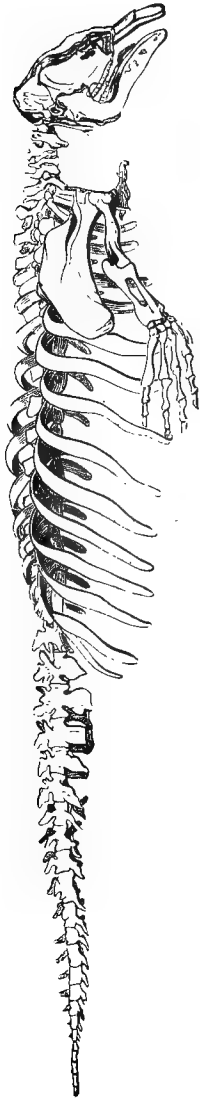
and its fore limbs are flippers, with vestiges of nails on the edges, enabling it to crawl on the shore. It feeds upon aquatic plants, whence it is styled an “herbivorous whale.”

ORDER CETACEA.

General Characteristics.—The Cetaceans are swimming, carnivorous mammals. They have nostrils on the top

says: “One evening my horse manifested uneasiness at a sound which approached us while we were traveling in the thick jungle. A turn in the road soon brought us to a tame elephant, without an attendant. It was carrying a heavy timber which it had balanced across its tusks, but the path being narrow, it was forced to bend its head so as to let the beam pass endways. The exertion and inconvenience led it to cry Urmph! Urmph! in a dissatisfied tone, and it was this sound which had alarmed my horse. The elephant, on seeing us halt, stopped, reconnoitred us for a moment, flung down the timber, and forced itself back into the brushwood to let us pass. As my horse still hesitated, the sagacious creature pressed still further one side, repeating its cry of Urmph! in an encouraging tone, as if bidding us come on. Finally my horse did so tremblingly, and when we were by, the elephant came out, lifted the timber, balanced it on its tusks, and resumed its march, snorting discontentedly as before.”

Fig. 131.



Skeleton of a manatee.

Fig. 132.

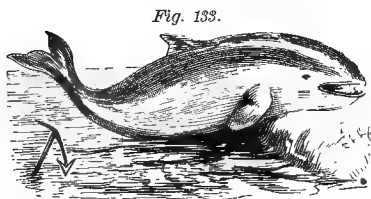


Skeleton of a Whale.

of the head; fore-limbs, which, like the human arm, consist of a shoulder-blade, humerus, radius, ulna, and five fingers; a tail, horizontally flattened and fluked; and no hind limbs. They are subdivided into Families, according to the presence or absence of teeth:

CETACEA. }	TEETH IN BOTH JAWS.	Delphinidæ,	<i>Dolphin.</i>
	" " LOWER JAW.	Physeteridæ,	<i>Sperm Whale.</i>
	" WANTING.	Balænidæ,	<i>Right Whale.</i>

Delphinidæ.—The *Common Porpoise* frequents the mouths of rivers, often venturing some distance up stream in pursuit of herring and other migratory fish.*



Phocaena communis, Common Porpoise. $\frac{3}{8}$.

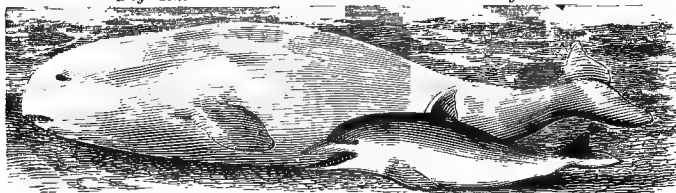
The *Delphinus delphis* is the Dolphin † of Grecian mythology.

The *Beluga* of the northern Atlantic coast is remarkable when mature for the clear white hue of its

skin, though when young it is black.

The *Narwhal*, or unicorn, has one of its upper canines developed into a straight, spirally-twisted pole of ivory, seven to ten feet long. ‡

Fig. 134.



Beluga canadensis, White Whale. $\frac{1}{12}$.

Fig. 135.

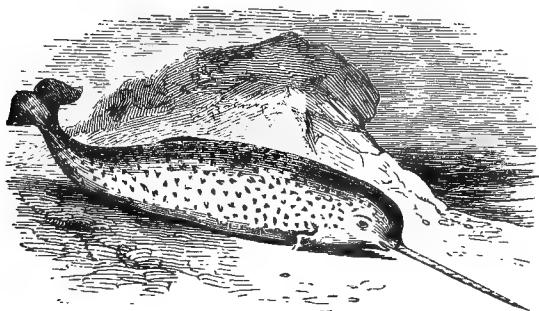
Delphinus delphis. $\frac{1}{8}$.

* It frequently comes to the surface of the water to breathe, where it tumbles and frisks about, presenting an appearance which has given it the name of the Puffing Pig.

† This is common to all seas, but should not be confounded with the Dolphin of sailors, which in dying displays all the colors of the rainbow—the latter being the coryphæne, a true scaly fish.

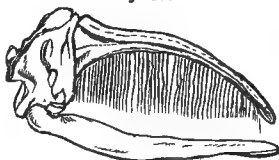
‡ This formidable weapon has been forced through the sides of a whale ship. It can be used only as a means of defence or of ploughing up the mud for food, as the animal feeds mainly upon soft shell-fish.

Fig. 136.

*Monodon monoceros*, Narwhal. 1856.

Balænidæ.—The *Greenland Whale*, being the one most sought by whalers, is known as the Right Whale. Its huge mouth is cleft to the depth of twenty feet, with a breadth of six or eight.* The upper jaw, instead of teeth, has slabs of whalebone (baleen) hanging freely, about an inch apart. These are often 1800 in number and the longest ten feet in length; the outer edges being smooth and solid, the inner fringed with fibres. In feeding, the whale moves rapidly forward near the surface of the water, not with open mouth, but with its lower lip dropped over, leaving the baleen exposed. The water rushes in, carrying myriads of minute animals. The great tongue being then raised and the lower lip lifted, the water is strained out through the baleen, and discharged at the sides of the mouth in torrents,† while the food remains, to be swallowed at leisure.

Fig. 137.

*Baleen.*

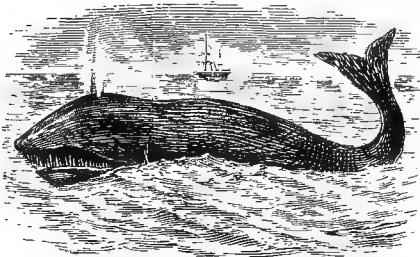
* Curiously, the throat opening out of this enormous cavity will hardly admit the entrance of the two fingers. As the whale has no teeth, it can therefore eat only very small animals.

† Close observers maintain that the whale in breathing never spouts water from the nostrils as the ordinary pictures represent. When it rises to the surface, a foot or more of water over the head is blown away by the breath escaping from the lungs. This is followed by the vast body of air expelled, surcharged with moisture hot from

The veins being destitute of valves, this huge animal bleeds to death from the single thrust of a lance, and in its last struggles, if the lungs are pierced, blood is forced out with the breath.

The whale has a reserve system of blood-vessels. As fast as the venous blood returns and flows into a waste reservoir, a portion of the extra arterial blood passes into the circula-

Fig. 138.



Balæna mysticætus, Right Whale. $\frac{3}{16}$.

tion, and thus it can remain under water for an hour. Being an air-breathing animal, it must come quickly to the surface; hence its tail* is flattened horizontally instead of vertically, that a rapid stroke may throw up the head. Its skin

consists of interlaced fibres, among which the fat is diffused to the depth, in some instances, of two feet,† forming the “blubber.” A wise Creator adapted this thick, non-conducting, India-rubber-like coating to withstand the tremendous pressure of the water ‡ and to protect the body from the freezing cold. §

To keep the water out of the lungs when diving, the blow-holes are provided with valves that, like a cork in a bottle, close more firmly the greater the pressure outside.

the lungs, which, cooling, changes to vapor, and in its circling descent resembles a shower of spray.

* The tail has often an area of 100 square feet, is exceedingly flexible, and so strong that the whale can spring clear out of the water “like little fish leaping into the air after flies,” falling again to the sea with a crash that is heard for miles.

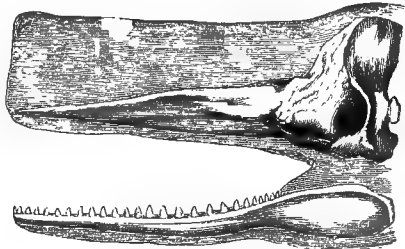
† In other animals, as the hog, the fat lies between the skin and the muscles.

‡ The whale often descends to the depth of a mile, where, according to Scoresby, the pressure upon it is equal to 200,000 tons, and wood becomes so watersoaked as not to rise again.

§ This enormous bulk of fat is lighter than the water and gives great buoyancy, so that the dead body of a whale floats until the layer of blubber is “flensed off,” when it sinks.

Physeteridæ.—The *Sperm Whale* is found in deep water in all tropical regions.

It has no baleen, and is distinguished by forty or fifty conical teeth in the lower jaw, which fit into cavities in the upper; and by a singularly-abrupt snout with blow-holes in front. An immense cavity in the head is filled with cells containing an oil which



Skull of a *Sperm Whale*, *Physeter macrocephalus*.

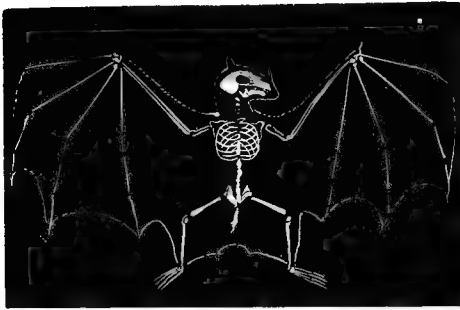
hardens into spermaceti. Ambergris is found in the intestines in masses of thirty or forty pounds.* The food of the Sperm Whale is mainly a molluscan animal called Squid. To procure this, it is said to descend into the water with its immense lower jaw hanging down perpendicularly. When a sufficient number, attracted by the glistening color of the teeth, are collected in the mouth, the treacherous jaw closes and the precious morsels are swallowed.

ORDER CHEIROPTERA.

General Characteristics.—The Bats are true flying mammals, the body of a beast being adapted to the life of a bird. The great change is a prolongation of the fingers, to sustain a semi-transparent membrane used as a wing. The thumb is left free and armed with a strong claw, enabling the bat to climb walls and to suspend itself, its favorite position when at rest. Its molars bristle with points for crushing its insect food. Its flight is that of a bird, though fluttering and lacking ease of movement. On the ground it can only drag itself along by its hooked thumb-

* This substance is very valuable, as it has the property of strengthening other perfumes. It is thought to be a product of disease, as it is oftenest found in sickly-looking whales.

Fig. 140.



Skeleton of a Bat.

nails. During the day it hides in caves, lofts, etc., and ventures out only with the twilight. Its eye is small and apparently of little service, as it flits among bushes and intricate

Fig. 141.

*Geoffrey's myotis*, Geoffrey's Bat.

passages when blinded.* Associated with ideas of gloom, it inspires universal dread, yet it renders great service by devouring noxious insects. To capture these, it curves for-

* This has led some Zoologists to think that it has a sixth sense. It is probably due, however, to its extraordinary delicacy of touch.—The cry of a bat is so shrill that many persons' ears cannot detect it, and Homer (*Odyssey* 24, 6) compares it to the cries of ghosts.—The bat is frequently infested with the common bed-bug (*Cimex lectularius*), and this fact may answer the question of the despairing housewife, "Where can the bugs come from?"

ward that part of the membrane expanded between the hind legs and tail, to serve as a skim-net. Its flight is uncertain and awkward, as ever and anon it dives downward, making complete somersaults in its effort to take the "catch" from the net. There are over 30 genera and 200 species—20 at least being indigenous to North America. The families of the order are as follows:

CHEIROPTERA.	With nose leaf,	SIMPLE;	{ FORE-FINGER TWO-JOINTED. }	Phyllostomidæ,	<i>Vampire.</i>
		COMPLEX;	{ FORE-FINGER ONE-JOINTED. }	Rhinolophidæ,	<i>Horse-shoe Bat.</i>
	Without nose leaf.	PROLONGED TAIL;	{ FORE-FINGER ONE-JOINTED. }	Vespertilionidæ,	<i>Common Bat.</i>
		SHORT, THICK TAIL;	{ FORE-FINGER TWO-JOINTED. }	Noctilionidæ,	<i>Hare-lipped Bat.</i>
		TAILLESS;	{ WITHOUT THIGH MEMBRANE. }	Pteropodidæ,	<i>Wing-footed Bat.</i>

Phyllostomidæ.—The *Vampire* of South America has, instead of a stomach, a long pouch for the reception of its

Fig. 112.



Phyllostoma spectrum, Vampire. $\frac{1}{2}$.

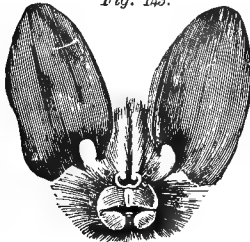
food, which requires little digestion. Its teeth make a triple puncture, through which it sucks the blood of its victim till gorged. The bite, however, is rarely serious.*

Rhinolophidæ.—The Horse-shoe Bats have large nose-appendages, consisting of skin curiously folded, perhaps as an extra organ of touch. The *Puff Bat* diminishes its spe-

* Most exaggerated stories have been reported by travelers, as that the Vampire, winging its silent flight in the darkness, poises itself over the exposed toe of an incautious sleeper, and painlessly extracts his life-blood, all the while by gentle fanning inducing a deeper slumber, until its victim expires.

cific gravity by blowing air beneath the cuticle through openings in the cheek-pouches until the creature looks like "a mere ball with head and limbs artificially attached." The *Great-eared Bat* has ears nearly as long as its body, folding them up when it sleeps. Their large development compensates for the smallness of the eyes; the diminutive size of which has given rise to the saying "Blind as a bat."

Fig. 143.



Megaderma frons, Great-eared bat.

Fig. 144.



Vespertilio subulatus, Little brown bat.

Vespertilionidæ.—The Common Bats are found in every part of the world. The *Little Brown Bat* frequents the haunts of man and is especially serviceable by destroying mosquitoes, while it is said that it will devour 40 flies at a meal. With the failure of food in the fall, it hides away to hibernate, when its respiration sinks from 200 to 30 per minute.

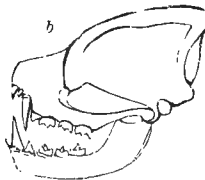
Fig. 145.



c



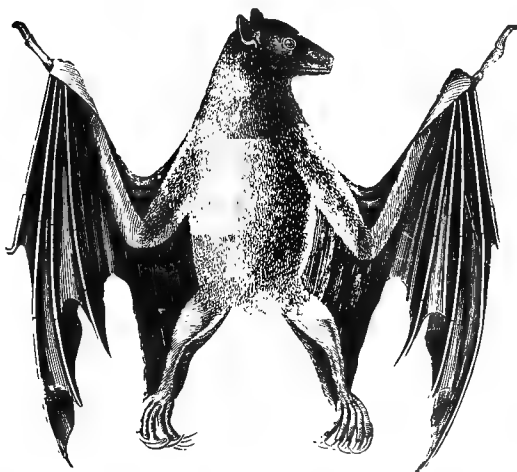
Noctilus leporinus, Hare-lipped bat.



Noctilionidæ.—The Noctilios of South America are repulsive from their cleft upper lip. Some have the hinder thumb placed at a distance from the rest of the toes and opposable to them, like the *Quadrumana*.

Some have the hinder thumb placed at a distance from the rest of the toes and opposable to them, like the *Quadrumana*.

Fig. 146.

*Pteropus edulis*, Flying Fox, Java.

Pteropodidæ.—The Wing-footed Bats are adapted to a vegetable diet. There are no points on their molars, and the pyloric, or digestive end of their stomach, is lengthened to correspond to their fruit-eating habits. The *Flying Fox*—so called from the shape of its head—is no larger than a squirrel, but is five feet across the wings. It receives its specific name because its flesh is eaten.*

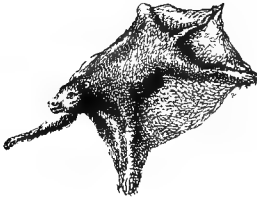
ORDER INSECTIVORA.

General Characteristics.—The members of this order are insect-eating, and have teeth studded with points for crushing the hard integuments of their prey. They are plantigrade, with a tendency to an underground life. Those inhabiting cold countries hibernate, as their food fails them during the winter.

* Hundreds are sometimes found suspended by their hind claws to the limbs of trees, presenting the appearance of uncommonly large fruit. If killed, they still remain hanging. They commit great depredations on orchards, and in Java the natives protect their trees by bamboo baskets.

INSECTI- VOROUS.	BODY COVERED WITH HAIR.	ARBOREAL.	Galeopithecidæ,	<i>Kabung.</i>	
		SUBTERRANEAN.	Talpidæ,	<i>Mole.</i>	
	BODY COVERED WITH SPINES.	TERRESTRIAL.	{	Soricidæ,	<i>Shrew.</i>
				Chrysochloridæ,	<i>Golden Mole.</i>
	TERRESTRIAL.	Erinaceidæ,	<i>Hedgehog.</i>		

Fig. 147.

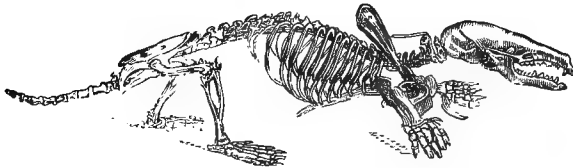


Galeopithecus volans,
Cat-monkey. $\frac{1}{5}$.

Galeopithecidæ.—The *Kabung** has a bat-like membrane clothed with hair, serving as a parachute to support it in a descending leap from tree to tree, sometimes for 100 yards. It is nocturnal and sleeps suspended by the hind legs.

Talpidæ.—The Moles are adapted to a subterranean life by having small eyes hidden in the fur, though capable of being brought forward for use; acute hearing and smell; velvet-like fur inserted vertically, so as to lie smoothly in any

Fig. 148.

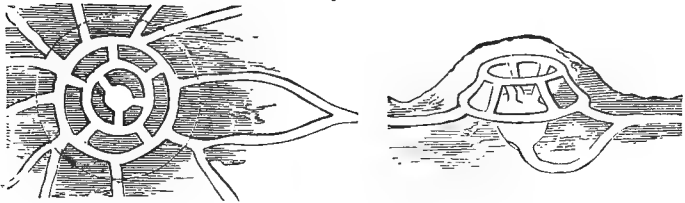


Skeleton of a Mole.

direction; shovel-shaped paws, with sharp, stout nails turned outwardly for throwing the earth backward; and cylindrical bodies for moving rapidly through their tunnels. The *Common Mole*, contrary to its specific name, lives upon land, often, in its pursuit of worms and insects, burrowing a

* The *Kabung* seems to be a transitional animal, linking different orders. The generic name, meaning cat-monkey, indicates this peculiarity. Its membrane allies it to the Cheiroptera; its teeth to the Insectivora; and its cranium and reproductive organs to the Quadrumana.

Fig. 149.



Habitation of a Mole.

gallery a hundred feet long in a single night. Strictly carnivorous, it is exceedingly useful, and should be protected by every cultivator of the soil. The *Star-nosed Mole* burrows in moist places to form chambers for rearing its young.*

Sorecidæ.— The *Shrew's* foot is not formed for digging, indicating its habit of living above ground. It has a long, movable snout, and bristly tail.†

Fig. 150.

*Scalops aquaticus*, Common Mole. †.

Fig. 151.

*Sorex thompsoni*, Thompson's Shrew. †.

* This species is frequently found in mid-winter with its tail swollen with fat probably to be absorbed as food during its partial hibernation.

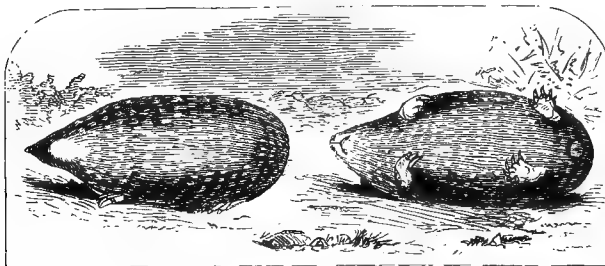
† Cats and dogs often kill them, mistaking them for mice; but on account of

Fig. 152.

*Condylura cristata*, Star-nosed Mole. †.

Chrysochloridæ.—The *Golden Mole* has short legs, a chunky body, and only three toes on the fore feet. Its fur shines with rich metallic tints of variable hues.

Fig. 153.

*Chrysochloris aureus*, Golden Mole, Africa. †.

Erinaceidæ.—The *Hedgehog* is not found in America. Mingled with its hair are prickly spines (quills) pinned through

Fig. 154.

*Erinaceus auritus*, Long-eared Hedgehog. †.

the skin from the inside, and retained by the head. They are so bent that when the animal rolls itself into a ball, they project in every direction—a cheval-de-frise which baffles the dog and the fox. If a pool is

near, however, the latter will sometimes tumble the curled-

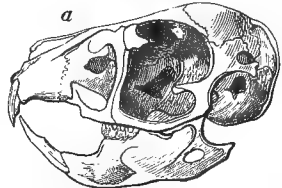
their disagreeable odor refuse to eat them. They are exceedingly pugnacious, and their fierce combats would be fearful were they not ludicrous from the diminutive size of the creature.

up hedgehog into the water; when the frightened animal, unrolling itself for an instant, will be caught by its crafty enemy before it can close up again.

ORDER RODENTIA.

General Characteristics.—The Rodents (gnawers) lack canine teeth, but have two upper and lower incisors fitted to gnaw bark, roots, woody stems, nuts, etc. These are long, slightly curved, chisel-edged, and deeply rooted in the jaw. Friction upon each other and constant growth at the base keep the edges sharp.* The molars are generally ridged transversely and the lower jaw moves backward and forward to aid in mastication. Most of the order have clavicles, and hence rotary motion of the fore paws, between which they hold their food while gnawing.

Fig. 155.



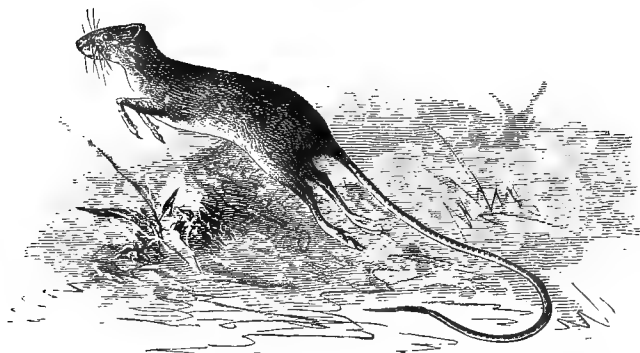
Skull of a Rodent.

}	RODENTIA.	{	With clavicles ;	}	MOLAR TEETH WITH ROOTS :	{	TAIL LONG, THINLY HAISED.	}	Jaculidæ,	<i>Jumping Mouse.</i>
						{	TAIL VARYING, SCALY.	}	Muridæ,	<i>Mouse.</i>
						{	TAIL LONG, PARTIALLY NAKED.	}	Geomyidæ,	<i>Gopher.</i>
						{	TAIL FLATTENED, SCALY.	}	Castoridæ,	<i>Beaver.</i>
		}	Without clavicles ;	}	MOLAR TEETH WITHOUT ROOTS :	{	TAIL LONG, BUSHY.	}	Sciuridæ,	<i>Squirrels.</i>
						{	TAIL SHORT, BRISTLY.	}	Hystericidæ,	<i>Porcupine.</i>
						{	TAILLESS.	}	Cavidæ,	<i>Guinea Pig.</i>
						{	TAIL SHORT, FURRY.	}	Leporidae,	<i>Hare.</i>

Jaculidæ.—*Jumping Mice* are remarkable for their cheek-pouches and long, zigzag leaps. There is but a single species in North America.

* If one of the incisors be broken off, its opposite continues to grow, sometimes curving, in which case at length it locks the jaw, and the wretched animal starves to death.

Fig. 156.

*Jaculus hudsonius*, Jumping Mouse. $\frac{3}{4}$.

Muridæ.—The Common Rats and Mice have naked tails; five toes on the hind feet; and four on the front, with a sort of wart representing a thumb. The *Meadow Mouse* is noticeable for the winding, shallow paths it traces among the

Fig. 157.

*Arvicola riparia*, Meadow Mouse. $\frac{3}{4}$.

grass leading to its nest. The *Deer Mouse* dwells in the woods and fields in summer, and in granaries in winter. The

Fig. 158.

*Hesperomys leucopus*, Deer, or White-footed Mouse. $\frac{3}{4}$.

House Mouse and the House Rat (*M. decumanus*), originally from Central Asia, are now found, through transportation by ships, in every part of the world.* The rat's tail is prehensile and can be used as a "hand, a balance, or a projecting spring." The *Musk Rat* lives on the river bank and in the water, using its vertically-flattened tail for sculling. Its home is constructed of reeds, with one entrance above and another below the surface of the water.

Geomyidæ.—The *Pouched Gopher* is so called from its curious, hair-lined cheek-pouches. These open externally, and are used for carrying out sand from its burrow and for taking in food.

Fig. 159.

*Mus musculus*, Common Mouse.

Fig. 160.

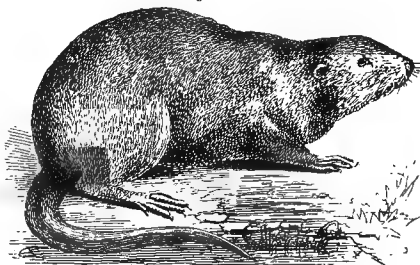
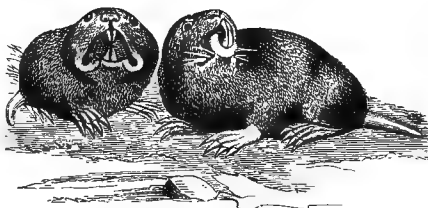
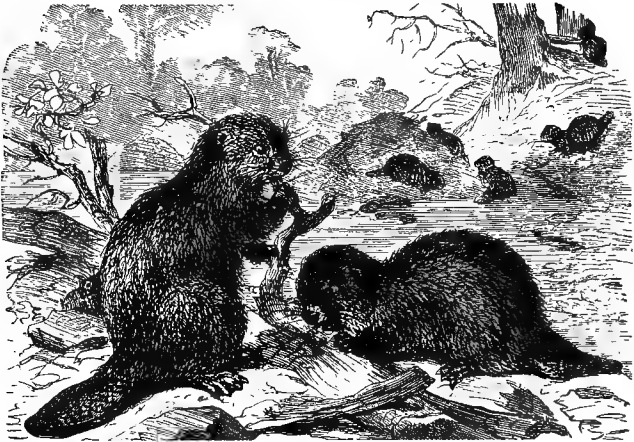
*Fiber zibethicus*, Musk Rat. $\frac{1}{2}$.

Fig. 161.

*Geomys bursarius*, Pouched Gopher. $\frac{1}{2}$.

* They are exceedingly cleanly and, in limited numbers, useful for their scavenger work and destruction of insect vermin. When food fails they migrate in companies to new places. In such journeys they often travel long distances and cross broad rivers. They take with them the old and infirm, and Dr. Franklin asserts that he once saw a rat leading a blind comrade by a twig grasped in its mouth.

Fig. 162.

*Castor canadensis*, American Beaver. †.

Castoridae.—The *Beaver* was once abundant in North America, but it retires before civilization, and is fast becoming extinct in this country as in Europe. Its scaly tail and webbed hind feet enable it to swim with great ease. The enamel of its incisors is very hard.* It is noted for its ingenuity in building its habitations.†

* The Indians, before the introduction of iron among them, were accustomed to use these as chisels for working wood and horn. A tame beaver will take an apple in its forepaws, and, by dextrously turning and pressing it against its incisors, pare it as readily as if the work had been done with a knife.—(Wood.)

† If the place chosen is by stagnant water, the beaver at once commences building on the bank, with lower entrances from the water; but, if it is a running stream, a large company combine to build a dam in order to keep the water at the same level. Going up stream they gnaw off trees one to ten or more inches in diameter. These they float down to the spot selected, and, laying them crosswise, fill in the interstices with mud and stone, which they carry between their forepaws and chin. When the water is high enough to prevent freezing to the bottom in winter, they separate into small families, and build their houses against the dam or the adjoining bank. The entrance is beneath the water, and the vaulted roof is well plastered with a thick coat of earth, to protect against the Wolverine. When they dive they always slap with their tail, and also when upon the tops of their houses inspecting them, or about their work. This has given rise to the absurd idea of their using it for a trowel to plaster their buildings, and as a hod to carry the mortar they are said to prepare.—They lay up food for winter by sinking logs and bark near their houses; but in summer feed upon grass, fruits and roots.

Sciuridæ.—The Squirrels have clavicles, and hence use their fore feet as hands. Their bushy tail aids them in leaping, the hairs spreading out and breaking their fall. They provide for winter by hiding nuts, which they skillfully cut from the stock. In the coldest weather they remain in their nests in a semi-torpid state, but with the first mild day are gamboling among the trees or skipping along the fences.

The *Southern Fox Squirrel* has the ears and nose white, the *Western* dark or black; while the body is gray, black, mottled, russet, or orange. The *Gray Squirrel* is the most abundant in New England and the Middle States, the black variety prevailing in Western New York.* The *Flying Squirrel* has an extension

* Congregating in great numbers, they venture into unknown regions in an undeviating course, swimming broad rivers (not sailing over on a piece of bark as fabulously related), sweeping through fields and forests, till the imperious but inscrutable instinct satisfied, they scatter and find homes.

Fig. 163.

*Sciurus vulpinus*, Southern Fox Squirrel. †.

Fig. 164.

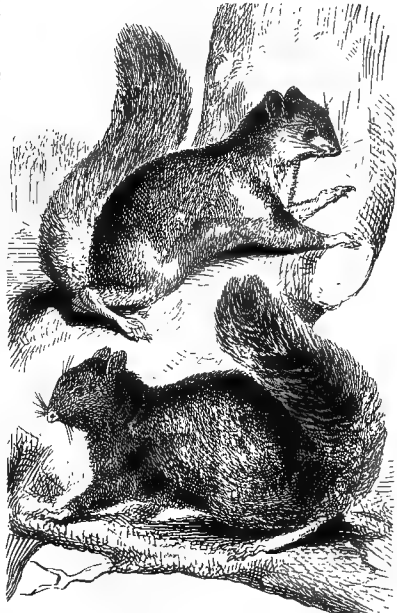
*Sciurus carolinensis*,
Gray Squirrel. Black variety of Gray. †.

Fig. 165.

*Pteromys volucella*, Flying Squirrel. $\frac{1}{2}$.

of the skin of the flank between the fore and the hind legs, which, with the flattened tail, forms a parachute to sustain it in leaping from tree to tree.* There is probably but one species in North America, differing in color and size according to locality. The *Chipmunk*, or *Striped Squirrel*, has cheek-pouches opening internally outside the teeth, capable

Fig. 166.

*Tamias striatus*, Chipmunk. $\frac{1}{3}$.

Fig. 167.

*Spermophilus tridecemlineatus*,
Striped Prairie Squirrel. † $\frac{1}{2}$.

* It is not *flight*, since the squirrel cannot propel itself in the air, nor even sustain itself at the same height. The first impulse being given by its powerful hind legs, it descends obliquely, and just before reaching the point aimed at, by an upward movement of the tail and the impetus of its velocity, ascends a short distance, and thus alights flat upon its four feet.

† In Iowa, Minn., Wis., and northern Ill, this squirrel is popularly known as the Gopher. The true animal of this name is given on p. 97. The former is sometimes destructive to crops in new districts, but a few pails of water will drive it out of its shallow burrow; while it fully recompenses all its damage by destroying mice and noxious insects.

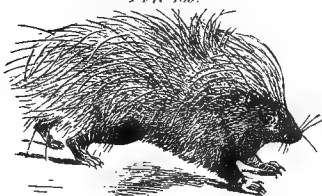
of carrying away four or five large acorns at a time. The *Striped Prairie Squirrel* is beautifully marked by thirteen stripes on a ground of reddish-brown. It is a western burrowing species. The *Prairie Dog* is found on the prairies west of the Mississippi. It has a short, puppy-like yelp, accompanied with a quick jerk of the tail. It digs a burrow, descending at an angle of forty degrees, and having a bed of dried grass at the end.* These are often placed close together, forming a dog-town reaching for miles. The animal has a curious habit of standing erect on the little mound at the mouth of its hole, watching intently, and at the first alarm tumbling down into its burrow.

Fig. 168.

*Cynomys ludovicianus*,
Prairie Dog. $\frac{1}{2}$.

Hystericidæ.—The *Porcupine* of North America has its back, sides, and tail covered with spines three to five inches long. These are barbed with numerous reversed hooks or prickles, which are easily detached, and, once embedded in the flesh, work deeper and deeper.†

Fig. 169.

*Hystrix cristata*. Porcupine, Europe. $\frac{1}{2}$.

Caviidæ.—The *Guinea Pig*, originally from South America, is domesticated in all parts of the world. Though exceedingly quarrelsome with its fellows, it is gentle toward other animals.

* Rattlesnakes and burrowing owls are often found sharing its home, being tolerated by the rightful owner from necessity.

† None of the species can throw their quills, though all can erect them by means of powerful subcutaneous muscles. When attacked the Porcupine, like the Hedgehog, rolls itself partially into a ball, and, brandishing its tail, stands ready for the onslaught. The assailant, with nose, lips, jaws, and tongue filled with the treacherous barbs, soon retreats with a howl of pain.

Fig. 170.

*Cavia cobiata*, Guinea Pig. $\frac{1}{2}$.

Leporidae.—The Hares are distinguished by two small teeth behind the chisel-like upper incisors. Flight being their only means of escape, their ears are peculiarly adapted to catch the faintest rustle and their eyes to look easily in every direction. When alarmed, they stamp with their feet, as if to give notice of danger; and,

with seeming consciousness of their mimicry, often merely squat behind a clod, and, suffering their pursuers to run over them, quickly start off in a contrary direction. They generally lie concealed during the day, and venture forth only at night, seeking their food of grass, roots and tender buds. In Europe they are hunted with dogs, the greyhound being kept almost exclusively for their pursuit.

The *Northern Hare* has in summer a tint of reddish-brown, and in winter an impure white. It never burrows,

Fig. 171.

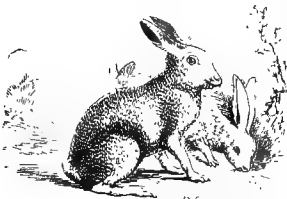
*Lepus americanus*, Northern Hare. $\frac{1}{2}$.

Fig. 172.

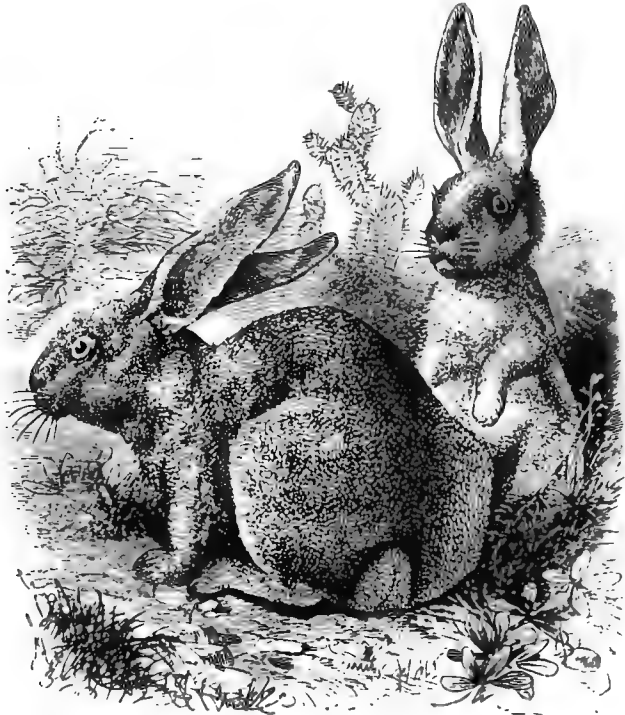
*Lepus sylvaticus*, Gray Rabbit.* $\frac{1}{10}$.

but makes a "form" of grass, etc., in which it crouches, its ears laid along its back, and trusting to its mimicry for concealment. It is a timid

* This animal, the smallest of the hares, is misnamed in this country, as there is no rabbit indigenous to America.

creature, loving the recesses of the thickest woods. It runs with great speed, and has been known to clear over twenty feet at a single bound. It is very fierce, however, and when overtaken will scratch and bite severely. The *Gray Rabbit*

Fig. 173.



Lepus callotis, Jackass Rabbit or Hare. 173

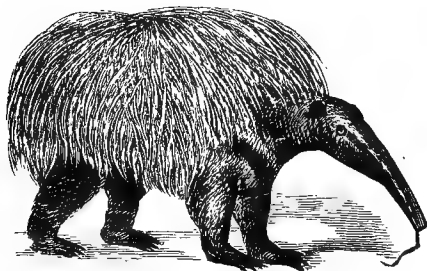
does not change its fur in the winter to so decided a white as the Northern Hare, or White Rabbit, as it is often called. Never making burrows itself, when pursued it will take refuge in those of other animals. The *Lepus callotis* of Texas and Mexico is remarkable only for its big ears.

ORDER EDENTATA.

General Characteristics.—The Edentates (toothless) are related only negatively by being destitute of incisors. Different members of the order being herbivorous, insectivorous, carnivorous, as well as omnivorous, no tabulation is given.

Myrmecophagidæ.—The *Giant Ant-eater* of South America has toothless jaws a foot long. It can open its

Fig. 174.

*Myrmecophaga jubata*, Giant Ant-eater.

mouth, however, only far enough to thrust forth its long, worm-like tongue.* This is covered by a viscid saliva, and can be darted hither and thither with lightning-like rapidity. With its fore feet, armed with powerful nails, it tears open an ant-hill, when the bewildered inmates rush out, and, sticking to its tongue, are rapidly swept into its mouth. When sleeping, it wraps itself in its large, bushy tail, presenting the appearance of a heap of dried grass, and thus escapes the notice of its enemies. Attacked, it rises, bear-like, upon its hind feet and clasps its enemy, its strong claws being a match for the Jaguar. It is, however, quite inoffensive, and rarely uses its great strength, even in its own defence.

* Though the animal is only four or five feet long, it is said that the thread-like tongue can be thrust out to a distance of two feet and as often as twice per second.

Bradypodidæ.—The Sloth,* of which there are two varieties—the two-toed and three-toed—is also peculiar to South America. The latter species, called the *Ai*, from its cry, lives on the under side of the branches of trees, even sleeping suspended back downward. Clinging to a limb with its short hind legs, it draws in other boughs with its long fore

Fig. 175.

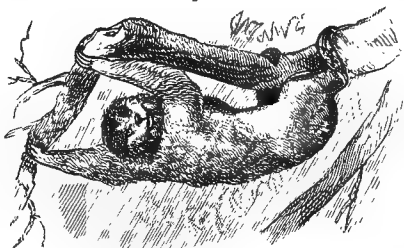
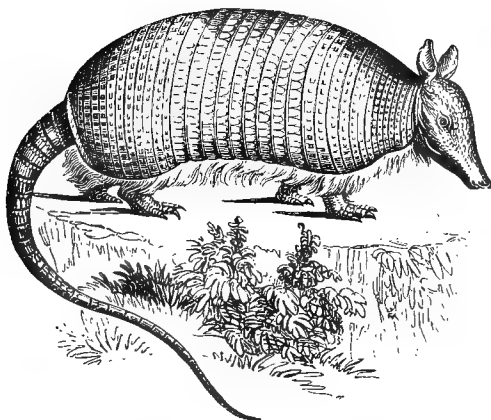
*Bradypus tridactylus*, Ai or Three-toed Sloth. ♀.

Fig. 176.

*Dasypus novemcinctus*, Nine-banded Armadillo. ♂.

legs, in order to strip off the leaves for food.

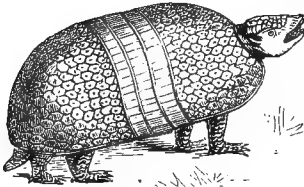
Dasypodidæ.—The Armadillos were so called by the Spaniards from their “coat of mail.” This bony armor consists of agglutinated hairs. The middle is divided into bands, to give freedom of motion. The animal’s snout is

* Cuvier said of this family, “Nature seems to have amused herself in producing something imperfect and grotesque.” Their fore legs are so much larger than their hind ones that when they try to walk on the ground they have to drag themselves along on their knees, and they seem awkward enough; but when moving on the forest trees they are seen to be in harmony with their intended life. In avoiding pursuit they spring from tree to tree with great rapidity, particularly in a gale of

pointed, for digging in search of roots and worms, and for hiding from its enemies.*

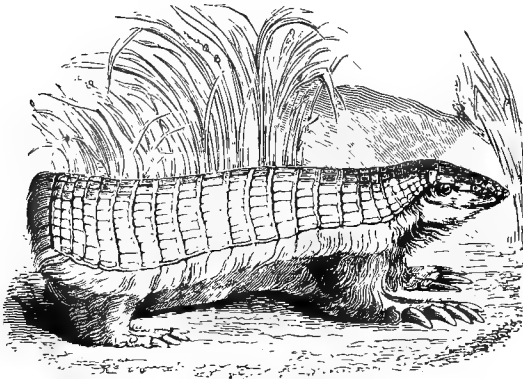
The *Nine-banded Armadillo* abounds in Central America, and is domesticated to clear the houses of ants. The *Mataco*, or *Three-banded Armadillo*, does not burrow, but for defence rolls itself into a ball. The *Pichiciago* resembles the mole in its habits. Its short tail, flattened at the end and bent under the body, serves to throw the earth backward when burrowing.†

Fig. 177.



Dasypus tricinctus,
Three-banded Armadillo. $\frac{1}{16}$.

Fig. 178.



Chlamyphorus truncatus, Pichiciago. * $\frac{1}{4}$.

wind when the branches are swaying toward one another. Their flesh is good eating and they need all their agility to escape their numerous enemies.

* Its legs are very strong, and Wood relates that he has seen an Armadillo running around with ease carrying three monkeys who had chosen to take a ride. When caught, though so small, it will kick with great effect. Some varieties will burrow so fast that it is said the animal will sink out of sight before a man on horseback seeing one can dismount and catch it. In Paraguay the natives detect the presence of an Armadillo in its hole by thrusting down a stick, when, if it is there, a swarm of mosquitoes will fly buzzing out.

† The Armadillos are the true scavengers of the plains, speedily devouring the carcasses of wild animals, and especially of such as have been slaughtered merely for their hides.

ORDER MARSUPIALIA.

General Characteristics.—The Marsupials (pouched) are not over an inch long at birth, but are immediately transferred to a pocket formed by the skin of the mother's abdomen. Nourished by milk, they remain there, as in a living cradle, till able to take care of themselves. Except a single Family, they belong to Australia and adjacent islands.

Macropodidæ.—The Kangaroos are noted for their small fore limbs and large hind ones. The latter with the powerful tail form a tripod to sustain the animal when sitting; but when feeding, it goes upon all fours, and the young often protrude their heads from the abdominal pouch and crop the herbage at the same time with the mother.



Fig. 179.

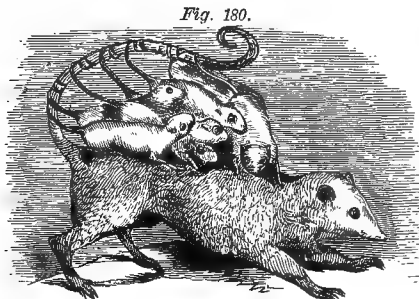
Macropus major, Kangaroo. 38.

Fig. 180.

Didelphys virginiana, Opossum.

When alarmed, the Kangaroo bounds off twenty feet at a leap.* Its eyes are large and have a peculiar gazelle-like expression in strange contrast to that of its gleaming white teeth. The different species vary in height from that of a rabbit to that of a man.

* It is eagerly hunted for its flesh and skin. When brought to bay by the hounds it seizes them with its fore limbs and endeavors either to drown them, if water be at hand, or to lay them open with its hind claw.

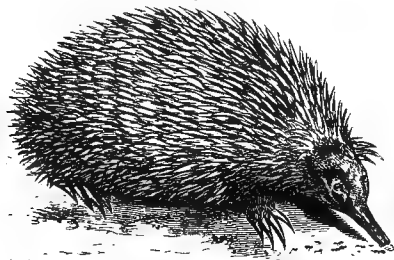
Didelphidæ.—The *Opossum* belongs to this Continent, but of the thirty species, only one is found in North America. The common variety is about the size of a cat, with a pointed head; large, naked ears; sharp teeth; rough tongue; long, prehensile tail; and curved claws.* It is mostly nocturnal and arboreal, and both herbivorous and carnivorous.

ORDER MONOTREMA the mole

General Characteristics.—The *Ant-eater* has a short tail, bent mes, found only in Australia and vicinity, form a projecting link between the Mammals and Birds.

The *Porcupine Ant-eater* has a nearly cylindrical beak covered with skin, except at the end, where there is a small

Fig. 181.



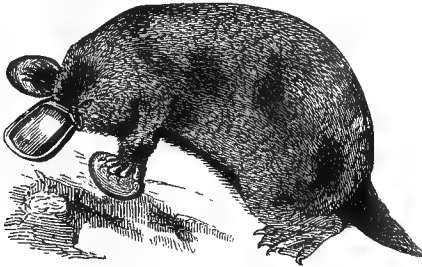
Echidna hystrix, Porcupine Ant-eater. $\frac{1}{2}$.

opening for its long, flexible tongue. It has no teeth, and feeds on insects. Its body is covered with hair and spines. When surprised, it rolls itself into a ball, or burrows flatwise into the earth with surprising rapidity.

* Hunting the animal is a favorite sport in some of the Southern States. In the bright moonlight evenings of the autumn, parties go out for this purpose with dogs. The opossum soon hides in the thick branches of a tree; but, when shaken down, rolls into a ball and feigns itself dead; after a few moments it slowly opens one eye, then the other, and if unhindered sneaks away. The young weigh only about four grains when put in the pouch, and are blind and deaf. Within a week their tails become prehensile enough to twine around one another's bodies. In five weeks they are able to crawl out and are sometimes found on the back of the mother, with their tails grasping hers, which, in turn, is twisted about a branch.

The *Water Mole** caps the climax of the eccentric Australian Zoology. The bill of a duck is attached to the body of an otter; while on each side of either mandible is a tooth without roots. In the sides of the mouth are capacious cheek-pouches. The fore feet have a web extending beyond their extremities, which can be folded up when the feet are used for burrowing, or expanded when employed in swimming. The hind feet are webbed only to the base of the nails. The body is covered with fur, beneath which is a layer of soft wadding, impervious to water. Its burrow runs underground forty or fifty feet, with one entrance under

Fig. 182.



Ornithorhynchus paradoxus, Water Mole. $\frac{1}{2}$.

water, and another just above. At the further end is a nest of grass for the rearing of its young, which are born and nourished like those of other mammals. It swims upon the surface, diving continually, and also, like the duck, thrusting its beak into the mud for food. So far as present discoveries indicate, it stands at the extreme of the mammals.

* See "Fourteen Weeks in Geology," p. 173.

CLASS II. AVES.

General Characteristics.—Birds are marked by being clothed with feathers. The modifications in the skeleton of a mammal necessary to adapt it for flight are very few, and are mainly those pertaining to the fore limbs and the breast-bone. The latter (*g*) is greatly enlarged to furnish support to the powerful muscles* which move the wings; and the

Fig. 133.



Skeleton of a Bird.

former have the bones below the elbow (*l*) more or less consolidated to give them a firm stroke against the air. The hand contains, in most species, three fingers. The clavicles (*j*) are generally united at one end, forming the "wish-bone." To strengthen the body the lumbar and sacral vertebræ are joined to the hip-bones (*r*), the dorsal are more or less united, and the ribs are ossified throughout, with each a process (*f*) lapping upon the

adjoining rib. The inner toe or thumb has two phalangeal bones; the next, three; the middle, four; and the last, five. The number of cervical vertebræ (*b*) varies from nine to twenty-three; and the upper one articulates with the skull by only one process, thus aiding in that variety of motion so essential in the act of "preening."

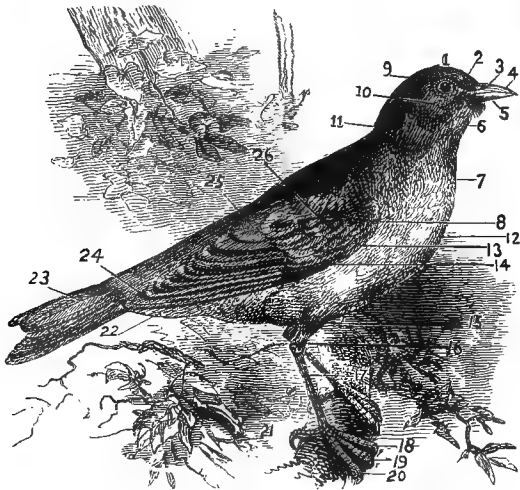
The bones are light. This is owing to their being composed largely of phosphate of lime, and the marrow in many of them being replaced by air. Singularly, at one stage they are solid, like those of all Vertebrates, but the bony tissue is afterward absorbed. "The thinnest-walled and widest air-

* The pectoral muscles form the great part of the so-called "breast" of a fowl.

bone of the bird of flight," says Owen, "was first solid, next a marrow-bone, and finally became the case of an air-cell."

The *Plumage* is a model of adaptation. The quills are hollow, and like the bones, filled with air. They are composed of the same substance, chemically, as the hair of mammals and the scales of fishes. The delicate filaments of a feather are covered with grasping barbs of a microscopic fineness. The under side of a feather is concave, to resist an upward

Fig. 184.



PLUMAGE OF A BIRD.—1, crown; 2, forehead; 3, nostrils; 4, upper mandible; 5, lower do.; 6, throat; 7, neck; 8, spurious quills; 9, occiput; 10, ear; 11, nape; 12, breast; 13, middle coverts; 14, large do.; 15, belly; 16, tibia; 17, tarsus; 18, inner toe; 19, middle do.; 20, outer do.; 21, thumb; 22, under tail-coverts; 23, tail; 24, primaries; 25, secondaries; 26, tertiaries.

pressure. On the tail is a gland containing oil, with which the bird lubricates its plumage and makes it waterproof. The whole plumage is renewed (molted) once or twice a year.

The *Wing* has a motion somewhat like the stroke of an oar; it strikes the air with the broad side, but, in returning, presents only the sharp edge. The flight of a bird offers

a curious problem. It is supposed that the upward pressure of the air caught in the saucer-like hollow of the wing cannot bend the inflexible bone and muscles of the front margin, but curves the ends of the elastic quills upward, pushing them forward, and so forcing the bird ahead.

Respiration takes place not only in the lungs, but also in the substance of the other organs; the air penetrating into the interior of the bones and feathers, sometimes even to the toes. So complete is this second process that it is said a bird will breathe through the end of a broken bone when the windpipe is tied.

Hatching birds' eggs requires a varying length of time, according to the species. The temperature needed is 104° Fahr. The chick first pierces its shell by a pegging motion of the hardened point of the under mandible, and then enlarges the aperture by pressing with the knob-like* end of the upper mandible. Finally, by turning from left to right, it breaks the shell about half around, when a vigorous stretch of the body, assisted by bracing with the feet, parts the shell transversely and the young bird is liberated.†

The class of birds is divided into orders as follows:‡

* This falls off soon after the chick emerges from its shell, as Nature abhors a useless appendage.

† Sometimes the fracture extends entirely around the egg, and the two portions are completely separated from each other. But if the inner membrane of the shell be not wholly divided, the connecting portion serves as a hinge, and the two parts of the shell may, in the movements of the young bird, become set, like two cups, one within the other.

‡ The classification of Birds is unsettled. Ornithologists have not as yet agreed even upon the number of orders. Attempts have been made to establish an ordinal system. Thus the form of the bill has been made a basis of separating the almost interminable series of Passerine birds into *Conirostres*, with stout, conical bill; *Dentirostres*, with a toothed and usually more or less hooked tip; *Tenuirostres*, with an elongated and awl-shaped bill; and *Fissirostres*, with a depressed, wide-gaped bill. These distinctions have proved unreliable and are generally discarded. In such uncertainty the classification here adopted is essentially that of Lilljeborg in "A History of North American Birds," by Baird, Brewer, and Ridgway. It is, however, considered only provisional. The fifteen orders given in the table have been subdivided by recent authorities into over one hundred families, several hundred genera, and at least ten thousand species. The limits of this book will permit the description of only one or two species typical of each family selected, American examples being generally chosen.

CLASSIFICATION OF BIRDS.

CLASS

ORDERS

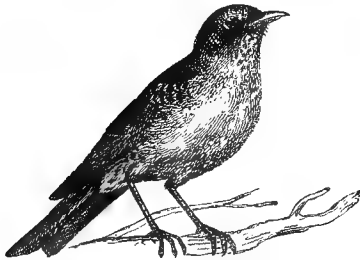
<p>AVES.</p> <p>Upper part of crus (tibia and fibula);</p> <p>free as well as the lower part of the femur. Base of hinder toe or hallux</p> <p>not free, but inclosed within the skin of the trunk. Feet palmate. Bill</p>	<p>Upper part of crus</p> <p>free as well as the lower part of the femur. Base of hinder toe or hallux</p> <p>not free, but inclosed within the skin of the trunk. Feet palmate. Bill</p>	<p>not elevated above the base of the anterior toes; the entire posterior toe insistent, rarely obsolete. Coverts of secondaries of first series</p> <p>not exceeding half the length of the secondary quills. Claw of the posterior toe not smaller than the claw of the anterior middle one.</p> <p>EXCEEDING HALF THE LENGTH OF SECONDARY QUILLS. TOES</p> <p>FEATHERED; POSTERIOR TOE RARELY ABSENT.</p> <p>NAKED; POSTERIOR TOE SOMETIMES WANTING. STERNUM</p> <p>lamellate</p> <p>without lamellæ. Hinder toe</p> <p>CONNECTED BY MEMBRANE WITH INNER TOE AND NEARLY LEVEL WITH OTHERS.</p> <p>FREE OR ABSENT. WINGS</p>	<p>two anterior and two posterior, or three anterior and one posterior, with the outer anterior versatile.</p> <p>two anterior and two posterior, outer not versatile.</p> <p>three anterior and one posterior. Bill</p> <p>without crest.</p> <p>with crest. Bill</p> <p>available for flight,</p> <p>unavailable for flight.</p>	<p>covered with a cere at the base and with the point of the upper mandible hooked.</p> <p>without cere or hook. Generally naked at base, or with large, swollen skin above nostrils.</p> <p>long, and usually flexible and sensitive.</p> <p>long, stout, and inflexible.</p> <p>short usually.</p> <p>long, passing beyond base of tail. Legs at centre of equilibrium.</p> <p>short, when closed scarcely reaching the tail. Legs posterior.</p>	<p>1. PASSERES. Thrush, etc.</p> <p>2. PICARIÆ. Woodpecker, etc</p> <p>3. PSITTACI. Parrot, etc.</p> <p>4. RAPTORES. Falcon, etc.</p> <p>5. COLUMBÆ. Dove, etc.</p> <p>6. GALLINÆ. Turkey, etc.</p> <p>7. BREVIPENNES. Ostrich, etc.</p> <p>8. LIMICOLÆ. Plover, etc.</p> <p>9. HERODIONES. Heron, etc.</p> <p>10. ALECTORIDES. Rail, etc.</p> <p>11. LAMELTIROS-TRES. Duck, etc.</p> <p>12. STEGANOPO-DES. Pelican, etc.</p> <p>13. LONGIPENNES. Gull, etc.</p> <p>14. PYGOPODES. Loon, etc.</p> <p>15. SPHENISCI. Penguin, etc.</p>
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ORDER PASSERES.

General Characteristics.—The Passeres (sparrows) always have the four toes on nearly the same level, with the hind one exactly opposite the others, giving great facility in perching.* They excel in vivacity and song.

Turdidæ.—The Thrushes are found in all parts of the world. The bird organization reaches in them its highest development, especially in the complex vocal apparatus of certain species.

Fig. 185.

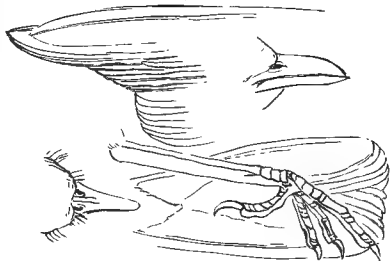
*Turdus migratorius*, Robin. $\frac{1}{2}$.

The *Robin* † alone of its family seems to court the society of man, following close upon the plough and spade and often nesting in a corner of the piazza. It is a ground bird, seldom picking worms from a tree, and never catching them as they dangle in

* They are therefore known also as *Insessores* or *Perchers*.—Some authors have subdivided this order into *Oscines*, songsters, and *Clamatores*, screamers. Amid such diversity any tabulation into families would be unsatisfactory.

† The following is taken from Baird, Brewer and Ridgway as a specimen of what every thorough teacher will require from each of his pupils in writing, with simple sketches attached, for every bird that can be obtained in the immediate vicinity;—“*TURDUS MIGRATORIUS*, *Robin*, American Redbreast. Tail slightly rounded; above olive-gray; top and sides of the head black; chin and throat white, streaked with black; eyelids and a spot above the eye, anteriorly white; under parts and inside of the wings chestnut-brown; the under tail-coverts and tibiae white, showing the plumbeous inner portions of the feathers; wings dark brown; the feathers all edged more or less with pale ash; tail still darker, the extreme feathers tipped with white; bill yellow, dusky along the ridge and at the tip. Length 9.75; wing 5.43; tail 4.75; tarsus 1.25 inches. Habitat, whole of North America.”

Fig. 186.



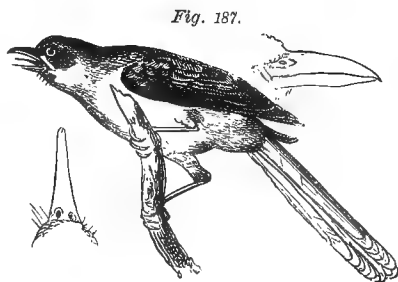
Sketch of principal parts of the Robin.

the air, but snapping them up the moment they touch the sod. One of the earliest-comers and latest-goers of the migratory birds, no one labors more zealously in the service of all, or, in comparison with the good it does, takes a smaller amount of toll.* The female robin sits fourteen days. Two broods are usually reared in a season, and often three in Southern New England and the Middle States.

The *Mocking-bird* † is remarkable for its varied melody and wonderful power of imitation. There is no song or sound which it does not mimic so perfectly as to deceive the most experienced ear. As it pours forth its medley of harmonious music and discordant noise, birds

answer to what they think is the call of their mates or the scream of the hawk; the dog hastens to what he imagines the whistle of his master; the hen hurries at the fancied cry of her frightened brood, and the child runs to the window, attracted by the supposed sound of a creaking wheelbarrow.

Saxicolidæ (rock-dwellers).—The *Blue-bird* alone represents this family in America, and the *Robin-redbreast* ‡ (*Erythacus rubecula*) typically in Europe. Were the blue of



Mimus polyglottus, Mocking-bird. †.

* However voraciously he may for a single month feed upon strawberries and cherries, the rest of the season he serves both the horticulturist and the agriculturist. In nothing is he injurious to the latter; while to both he is invaluable for destroying the larvæ of almost every insect found upon or (within the length of its bill) beneath the surface of the soil. Wherever the robins and birds of similar habits are destroyed, these insects and worms increase to an alarming extent. A wise Creator has designed the birds not only for ornament and pleasure, but to serve a definite purpose in protecting vegetation. Prudence would teach us to protect them as our faithful servants.

† Southern Pennsylvania is the usual northernmost limit of the Mocking Bird, although it has been known to breed for successive years in Massachusetts.

‡ The European Robin-redbreast must not be confounded with the American robin, which, as we have seen, belongs to a different family.

the former replaced by the brown-olive of the latter, the two birds could hardly be distinguished.*

Fig. 188.

*Sialia sialis*, Blue-bird. $\frac{1}{2}$.

on the lowering of the bill, throws the centre of gravity in front of the feet and gives the body a constant tendency to tumble forward. The quickly-expanding tail striking against the air, raises the head again with little effort.

Fig. 189.

*Motacilla alba*, White Wagtail. $\frac{1}{2}$.

Fig. 190.

*Philomela luscinia*, Nightingale. $\frac{1}{2}$.

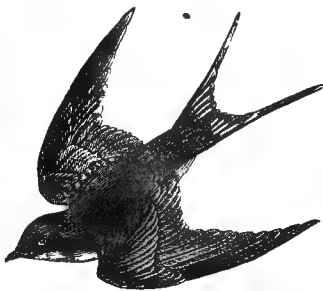
Sylvicolidæ (wood-warblers). — The *Nightingale* of Europe has been famed from time immemorial for the sweetness of its voice. It is a shy bird, but its song is occasionally heard during the day, though it is most pleasing in the

* Their social nature corresponds as fully as their physical, and the blue-bird would figure as appropriately in the beautiful legend of "The Babes in the Wood" as the traditional robin-redbreast.

silence and serenity of a moonlight evening. Both sexes sing, though the male excels. Its plumage is a modest reddish-brown above and a whitish-gray beneath—a mimicry adapting it to the foliage among which it loves to hide itself.

Hirundinidæ.—The Swallows have long wings, which enable them to be almost constantly in flight.* The *Barn Swallow* is the most common species, and is deservedly a favorite, as there is no evil blended with its many benefits. Purely insectivorous, it destroys alike the pests of fruit trees, of cattle, and of man.

Fig. 191.

*Hirundo horreorum*, Barn Swallow. ♀.

Ampelidæ (wax-wings).—The *Cedar-bird* is noticeable for the exquisitely fine and silky texture of its plumage; its erectile crest; and the remarkable appendages to the shafts of the secondaries (and sometimes to the tail), of a bright vermilion, resembling red sealing-wax. It appears in New England about the last of May, in flocks of fifteen or twenty, ridding the orchards of the destructive span-worm and the canker-worm; and then pairing off and nesting late in June or early in July. In return for its

Fig. 192.

*Ampelis cedrorum*, Cedar-bird. ♂.

* The Swallow attains the rate of more than a mile a minute, which, if sustained during ten hours a day for ten years, the supposed life of the bird, would give over two million miles, or upwards of eighty-seven times the circumference of the globe.—The wide-spread belief that the flying high of swallows indicates settled fair weather, and the flying low foul weather, may have foundation in the barometric changes of the atmosphere, varying the height of the strata of air in which they forage for insects.

invaluable services, it helps itself somewhat freely to the smaller fruits, and hence is most unwisely persecuted.*

Fig. 193.

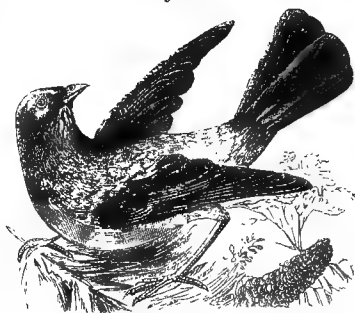


Collurio borealis, Shrike or Butcher-bird. ‡.

being feeble, it impales its victims upon thorns, often a number at a time on the same bush, that it may eat them at its leisure. While dismembering, it cunningly stands upon the inner side, so as to transfix them more completely.†

Tanagridæ.—The male *Scarlet Tanager*, in the third and following years, has, with the exception of the jet-black wings and tail, a fiery-red plumage, in brilliant contrast with the green leaves among which it flits. After the August molting, and during the first year, it is not distinguishable, in its greenish livery, from the female, its gay summer plumage being assumed on re-entering our southern borders in the spring. The birds of this family feed mainly upon the insects in the topmost branches of trees,

Fig. 194.



Pyrranga rubra, Scarlet Tanager. ‡.

* Often alighting side by side, the outer one of the series will pluck a cherry within reach and pass it to the second, and he to the third, and so on to the end, and then back again to where it started, repeating the manœuvre several times, until, the appetite whetted up, some one of the line will take a bite and spoil the fun.

† In like manner it has been observed, when in confinement, to weave the body of a mouse between the wires of the cage, that it might bear a heavier pull while being torn in pieces.

and claim protection as among the most useful of our songsters.

Fringillidæ.—The Finches* are distinguished by a short, conical bill, usually notched. The *Song-sparrows* are our earliest and latest musicians. Those nesting in the far north pass the latitude of New England late in November, and return in early March; always in full song, with notes “louder, clearer, and more vibratory than those that come to us and remain to breed.” † It nests both on the ground and in trees, only the older birds selecting the latter, as though taught by experience the greater security.

Fig. 195.

*Melospiza melodia*, Song Sparrow. $\frac{3}{4}$.

Fig. 196.

*Curvirostra leucoptera*.
Curvirostra americana.
Cross Bill. $\frac{1}{2}$.

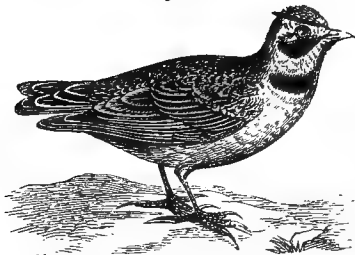
The *Cross Bill*, when matured, has its mandibles lapping, though the young do not possess this peculiarity. While this anomalous form does not unfit the bird for eating

* The necessity of examining not only a great number of specimens of the same bird, but also those from different localities, is especially apparent in this family. Each region of North America seems to possess a different variety. So completely, however, do the forms of a series of hundreds of specimens from different places insensibly grade into one another, that eight species have been united in one by recent authors

† Individuals have been known to sing “nine entirely different sets of notes,” usually uttering them one after another in the same order.”

insects and soft fruit, it peculiarly adapts itself to obtain food from the seed of pine and fir cones.*

Fig. 197.

*Eremophila cornuta*, Shore Lark. †.

Alaudidæ.—The Larks are distinguished by long and nearly straight hind claws. The *Shore Lark* is the only representative indigenous to North America, but the most noted is the European *Skylark*, now partially domesticated in the United States. It rises with

quivering wings almost perpendicularly, singing the while, until it passes out of sight, though not out of hearing; and then, closing its wings, drops headlong down into the meadow again, in a very ecstasy of song.

Icteridæ.—The *Bobolink* is one of the most beneficial or destructive of birds, according to the season of the year and the locality. In its spring migrations, it is the pest of the Southern wheat-fields; and in its autumnal flight, of the rice plantations. It renders, however, a redeeming service in devouring cotton-worm larvæ, and in its breeding-places it is purely insectivorous. The female conceals her nest on the ground among the standing grass by alighting or rising a distance from it.†

Fig. 198.

*Dolichonyx oryzivorus*,
Bobolink, or Rice-bird. †.

* These seeds are concealed beneath hard scales. To secure them the bird, clinging to the slender twig with one foot, grasps the cone with the other; then inserting its bill between the scales, by drawing the lower mandible sideways, pries them apart, when the tongue, which is furnished with a peculiar horny scoop, darts into the opening, dislodges the seed and carries it to the mouth.

† The grotesque, though charming song of the Bobolink is a curious medley of jingling, incomprehensible notes, uttered with a volubility and earnestness that borders upon the ludicrous, especially when thirty or forty begin, one after another, and

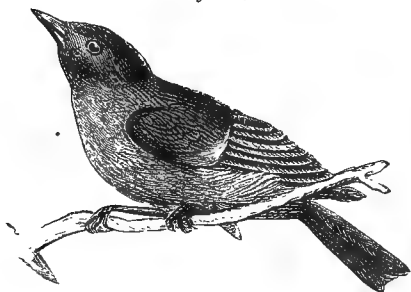
The *Cow-bird* is gregarious and polygamous, exhibiting neither conjugal nor parental affection. The female lays in the nests of other birds, usually those of similar appetite, and whose eggs hatch two days later. The adopted nestling being larger, obtains the greater share of food, and its foster companions are generally soon stifled or starved.*

Fig. 199.

*Molothrus pecöris*, Cow-bird.

The *Baltimore Oriole*, noticeable for its brilliant plumage, almost invariably reaches the latitude of Southern New England on the 10th of May.

Fig. 200.

*Icterus baltimore*, Golden Robin. †.

Its rich and full-toned melody defies verbal equivalents. † Though pernicious by injuring the pea-crop, it more than compensates by destroying the canker-worm and the tent-caterpillar, which few birds venture to disturb. The oriole's nest is composed of vegetable fibres, hair, etc., woven into a kind of purse hung from the end of a limb. ‡

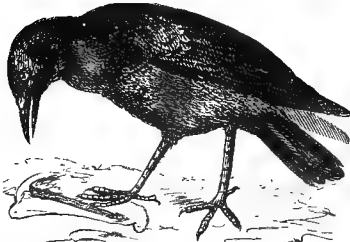
at length get into an exact concert; but, when the listener is just beginning to be enraptured, the music ceases as suddenly as if an organ-bellows had burst.

* Their dead bodies are probably removed by their parents, as they are never found near the nest, which would be the case, if, like the cuckoo of Europe, they were thrown out by the young cow-bird.

† Nuttall describes the notes of its song thus: Tshippe-tshayia-too-too-tshippe-the-tshippe-too-too. The failure will be apparent to all who compare it with the original.

‡ In the museum of Brown University is a nest originally sustained by threads fastened around two twigs forming a fork. One of the twigs breaking off three days before the young were ready to fly, the old bird procured a piece of twine at least

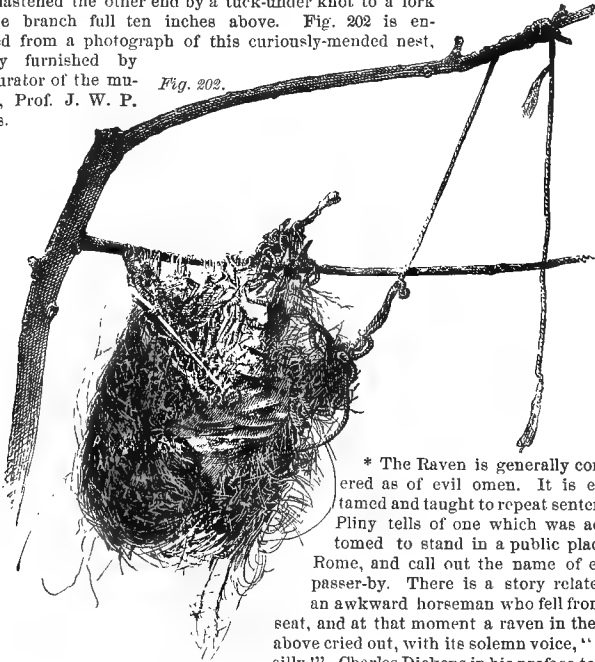
Fig. 201.

*Corvus corax*. Raven. $\frac{1}{2}$.

Corvidæ.—The true Crow and the Jay pass so insensibly into each other as hardly to present a dividing line. The *Raven*, though rare in the Eastern States, is generally distributed throughout North America.* It exhibits wonderful sagacity in

two feet in length, and, after winding several inches of one end many times around the part of the branch still imbedded in the matting of the nest, drew all taut and then fastened the other end by a tuck-under knot to a fork in the branch full ten inches above. Fig. 202 is engraved from a photograph of this curiously-mended nest, kindly furnished by the curator of the museum, Prof. J. W. P. Jenks.

Fig. 202.



Nest of Oriole.

* The Raven is generally considered as of evil omen. It is easily tamed and taught to repeat sentences. Pliny tells of one which was accustomed to stand in a public place in Rome, and call out the name of every passer-by. There is a story related of an awkward horseman who fell from his seat, and at that moment a raven in the tree above cried out, with its solemn voice, "How silly!" Charles Dickens in his preface to *Barnaby Rudge*, gives his amusing experience with tame ravens. Our *Common Crow* (*Corvus americanus*) can be distinguished from the Raven by being much smaller and by

our *Common Crow* (*Corvus americanus*) can be distinguished from the Raven by being much smaller and by

cluding the hunter, seeming to detect at a glance the difference between a person going quietly about his business and one "on mischief bent."

Fig. 203.



The *Blue Jay's* pleasing plumage is in startling contrast with the harsh notes of its ordinary song. Though irritable and quarrelsome, it has been tamed and taught to pronounce certain words. It is of great service in planting the seeds of forest trees and in devouring, during the winter season, the eggs of the destructive tent-caterpillar.

Ploceidæ.—The Weaver-birds are *Cyanitra cristata*, Blue Jay. ♀. found only in India and Africa, and are named from the inimitable construction of their nests. Some are pendent from the twigs of tall trees overhanging a stream, and are shaped like an inverted bottle or chemical retort, with a long tube for the entrance, made of fibres so loosely put together that a reptile would drop off into the water. Others similarly suspended are pyramidal in shape and divided into two chambers—the outer, perhaps, for the use of the male and the inner for the eggs.

Fig. 204.



Nest of Sociable Weaver-bird.

The *Sociable Weaver-bird* is polygamous. A colony of two or three hundred con-

having its throat-feathers oval and close; while those of the raven are sharp and scattered. The *Rook* (*C. frugilegus*), so familiar to every European traveler and which congregates in flocks about churches and old ruins, does not eat carrion. The fondness of the raven for such food explains why the one sent from the Ark by Noah returned no more to him.

Fig. 205.

*Ploceus socius*, Sociable Weaver-bird. ♂.

struct in a tree a huge, sloping roof, impervious to rain. Beneath this, side by side, each female makes her nest, three or four inches in diameter, weaving it to the roof. When completed, the lower surface of the umbrella-like structure appears perforated by small openings, like the cells of a bee-hive,

all the birds living together in perfect harmony.

Paradisoidæ.—The Paradise-birds are natives of New Guinea and the adjacent islands. The *apoda** (footless) is the most beautiful. The brilliant plumed tufts beneath its wings and the bright emerald green of its head and neck are particularly striking.

Menuridæ.—The *Lyre-birds* of Australia are noticeable for the shape of the tail and their habit of making small round hillocks, on which the male is continually trampling while gracefully erecting and spreading its plumes.

Fig. 206.

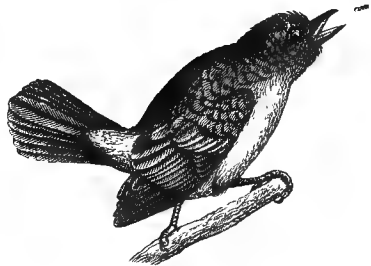
*Paradisæa apoda*,
Emerald
Bird of Paradise. ♂.

* The bird was so named from the absurd belief prevailing, when it was first introduced to the civilized world, that it had no feet, the cunning natives being accustomed to cut them off, and to assert that the bird hung to the trees by its plumes, and that it passed the breeding-season in Paradise, fed on dew.

Fig. 207.

*Menura superba*, Lyre-bird. 16.

Fig. 208.

*Myiarchus cinerascens*,
Great Crested Flycatcher. 4.

Tyrannidæ.—The Fly-catchers are American, though comparatively few of the genera belong to North America. They are not strictly insectivorous, but in general are indispensable to the farmer.

The *Great-crested F.* is extending its habitat northward and eastward to localities where it was unknown at the beginning of the century. It makes its nest in hollow trees or stumps, generally lining it with cast-off snake-cuticles.

ORDER PICARIÆ.

General Characteristics.—To the peculiarities of this order given in the table, p. 113, may be added their altricial nature, though the young are in some species hatched with down.

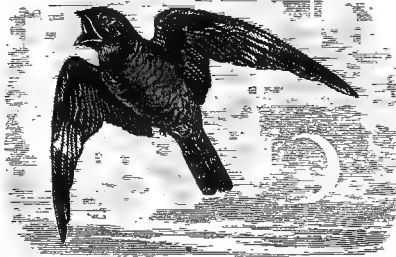
Alcedinidæ.—The *King-fishers** have a long, pointed beak, and the outer and middle toes united as far as the last joint. For nesting, they dig holes ten to fifteen feet deep in a sandbank.

* They always bring the fish out of the water seized near the tail. If small, it is swallowed immediately, head foremost; if large, it is carried to a rock or stump and thrashed till dead.

Caprimulgidæ (goat-suckers).—
The *Night Hawk*,* notwithstanding

Fig. 210.

Fig. 209.



Chordeiles popetue, Night Hawk. †.



Ceryle alcyon,
Belted King-fisher. †.

its popular name, retires to rest at the close of twilight, when it can no longer discern its insect prey.† Its sharp squeak is occasionally varied by a loud, booming sound, emitted when its downward flight is arrested during a swoop near the surface of the earth.‡ Its two eggs are usually laid on a rock or some

place exposed to the sun, without any nest, though the mother broods them assiduously, fluttering away, when alarmed, as though wounded. If disturbed, it will, like the whippoorwill, carry off the eggs or young in its capacious mouth to another locality. The *Whippoorwill* is silent during the day,

Fig. 211.



Antrostomus vociferus, Whippoorwill. †.

* The *Night Hawk* and *Whippoorwill* are commonly believed to be identical. They are really, however, distinct not only in color markings, but also generically, thus:

CAPRIMULGIDÆ. {	GAPE WITHOUT BRISTLES.	Tail narrow, forked :	<i>Night Hawk.</i>
	GAPE WITH BRISTLES.	Tail broad, rounded :	<i>Whippoorwill.</i>

† Its singular habit of perching lengthwise on a limb or rail is well known ; but in confinement it often perches across a finger, or the back of a chair.

‡ The former sound is produced by its vocal organs; the latter, by a quick, vibrating motion of the wings.

but at night comes forth to watch for beetles, moths, etc. If it does not seize an insect at the first dash, the exceedingly sensitive bristles lining the sides of the upper mandible tell which way the prey is moving. After each sally it returns to the same spot. Its middle toe is pectinated, doubtless for cleaning its bristles.

The *Chuck-will's-widow* of the South is larger than the Whippoorwill, and has bristles with lateral filaments.

Trogonidæ.—The *Trogons* of the tropics are pre-eminent for brilliancy of plumage.*

Cypselidæ.—The *Swift*† alights readily on a perpendicular surface, to which it clings with its sharp claws and short spined tail. The *Chimney-swallow*, the only

* The ancient Mexicans kept large aviaries of these birds both on account of their beauty and their gorgeous plumes, which were plucked at a certain season and worked into mosaic images and pictures.

† This bird is so called from its unrivaled power of wing, though it lacks the speed and grace of the *Hirundiinæ*.—One species of this family (*Collocalia esculenta*) is the principal maker of the "Edible birds' nests." These are constructed with bits of sea-weed, metamorphosed in the bird's stomach, disgorged and attached to the rocks. When washed and soaked, they form a gelatinous substance highly esteemed among the Chinese for making soup. The nests are taken down three or four

Fig. 212.



Trogon resplendens,
Resplendent Trogon. 16

Fig. 213.

*Chaetura pelagica*,Chimney-swallow or Swift. $\frac{1}{2}$.

They are the smallest as well as the gayest of birds, blending in their rich plumage the rarest colors of flower and gem. Their bills, shaped according to the form of the blossom they are designed to penetrate for insects, vary greatly—some being short and straight, others longer than their bodies, and yet others greatly curved. The humming-bird can fly so rapidly that the eye can scarcely follow its flight, or, by beating the air with its wings, sustain itself in front of a flower almost immovable. All the species build tiny,

times per year from the caves to which the swallows are accustomed to resort, the old nests being destroyed to compel the birds to build new ones, which, when fresh and unused, bring their weight in silver. The proprietors of a cave in Java are said to receive 50,000 florins annually for rent, and 4,000,000 nests are yearly exported from the coast of Cochin China.

American species, with its feet, while on the wing, adroitly breaks off twigs and fastens them to the chimney with its tough, glue-like saliva so strongly that the brick to which the nest is attached will sometimes yield before the cement.

Trochilidæ. — Humming-birds are peculiarly American. About 450 species are recognized, yet only one, the *Ruby-throated*, visits the North Atlantic States, and but ten any part of the United States.

They are the smallest as well as the gayest of birds, blending in their rich plumage the rarest colors of flower and gem. Their bills, shaped according to the form of the blossom

Fig. 214.

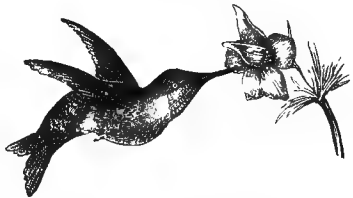
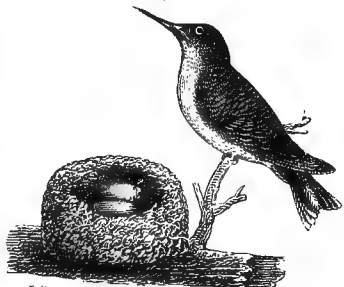
*Trochilus colubris*,Ruby-throated Humming-bird. $\frac{1}{2}$.

Fig. 215.



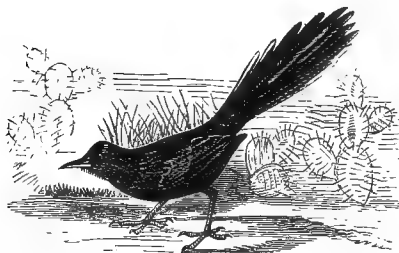
Nest of Humming-bird.

cup-shaped nests of vegetable down, with an outer coating of lichens glued on with saliva. Each contains two little white eggs, the size of a pea.

Cuculidæ.—The Cuckoos inhabit all countries. Their toes are in pairs, the exterior being somewhat reversible, in one species entirely so. The only species found in England is parasitical in its incubation, like the American cow-bird. Its young, however, hatches simultaneously with its nest-companions, whom it soon tosses out upon the ground to perish.

The *Road Runner*, a ground bird* found in southwestern North America, is so swift of foot that for a quarter of a mile it will outrun a fleet horse.

Fig. 217.



Geococcyx californianus, Road Runner. $\frac{1}{2}$.

will eat.† Unlike the European species, they build a nest, though it is rude and airy. Laying their eggs, however, at long intervals, they protract the breeding season from one to four months; the same nest often containing a freshly-laid

Fig. 216.



Coccygus americanus,
Yellow-billed Cuckoo. $\frac{1}{2}$.

The *Yellow-billed Cuckoo*, with its near relative, the *Black-billed* (*Coccygus erythrophthalmus*), is found throughout North America. They are both fond of hairy caterpillars, which few birds

* It always carries the beetles and snails on which it feeds to a particular spot in order to break the shell, and thus piles of the broken fragments collect at that place.

† The cuckoo's gizzard is often found lined with caterpillar's hairs, so tenaciously adhering by their minute barbs as to require microscopic examination to prove that they do not grow from the coating of the stomach.

egg, one just hatching, a young bird partly fledged, and another ready to fly.

Rhamphastidæ.—The *Toucan** is noted for an enormous bill. Its honeycomb structure, however, makes it light, and its form adapts it to extract eggs from deep holes and nests for food.

Fig. 218.



Rhamphastos tucanus,
Toucan, South America. $\frac{1}{2}$.

Fig. 219.



Campephilus principalis,
Ivory-billed Woodpecker. $\frac{1}{10}$.

Picidæ.—The Woodpeckers are the typical Zygodactyles (yoke-toed), having toes in pairs, one before and one behind. Their tongue can be thrust far out, and a hole once made to the lurking-place of an insect, the tip, barbed on the upper side and viscid with saliva, quickly transfers the victim to the gullet of its captor. The spiny tail of most of the species aids in supporting the body. The lustrous, white eggs are laid on chips at the bottom of their holes.

The *Ivory-billed Woodpecker* is the largest north of Central America. With its wedge-shaped bill it can bore a hole three feet deep for its nest in the trunk of a living tree.† As

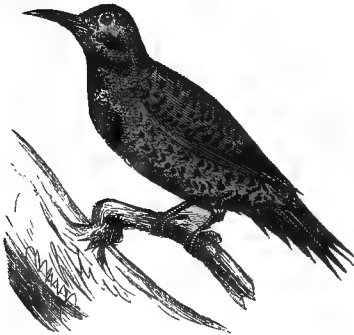
* The word Toucan means feather, and refers to its barb-covered tongue. On account of its habit of assembling in flocks to chatter, it is called among the natives the Preacher-bird.

† This bird is so strong that strips of bark several inches in length are often detached at a single blow, and with such rapidity as to sound like a falling shower.

a protection from the rain, it generally makes the opening under a large branch. Its undulating flight, often by a single sweep from tree to tree, as if the bird had been swung with closed wings in a curved line, is the perfection of graceful movement.

The *Golden-winged Woodpecker* is the most extensively distributed through North America, and the most beautifully colored of its family. The male cannot be distinguished from the female, except by the black patches on its cheeks, looking like side-whiskers.

Fig. 220.



Colaptes auratus,
Golden-winged Woodpecker. ♂.

Fig. 221.



Picoides hirsutus,
Banded Three-toed Woodpecker. ♂.

The *Three-toed Woodpecker*, of which there are three species, is rarely found south of the Canadas or Northern Maine.

ORDER PSITTACI.

General Characteristics.—The Parrots have a thick bill, the upper mandible strongly hooked at the end, with a naked space at the base; tongue fleshy and round; and neither toe versatile. In captivity they may be taught to imitate the human voice, but not as well as other species of birds.* The only family (*Psittacidæ*) embraces about three

* Its language is often so pat as to show that the bird really understands its use. Goldsmith tells a story of a parrot belonging to Henry VIII, which fell into the

Fig. 222.



Conurus carolinensis,
Carolina Parrot. $\frac{1}{2}$.

Fig. 223.



Cacatua sulphurea,
Sulphur-crested Cockatoo. $\frac{1}{2}$.

hundred and fifty species, fully one-half belonging to South America.

The *Carolina Parrot*, the single species found in the United States, is rapidly becoming extinct. Its curiosity is its greatest foe. One of a flock being shot, the rest will keep alighting near by, till all are captured.

Cockatoos are forms often seen in our menageries. One genus is distinguished for its size and erectile, sulphur-colored crest, but especially for its longevity—individuals having lived in captivity more than a hundred years.

ORDER RAPTORES.*

General Characteristics.—The canine teeth and power-

Thames. It immediately bawled out "A boat! a boat! twenty pounds to save me." A man thinking some one was drowning, threw himself into the river, but was astonished to discover it was only a bird. Finding the king was its master he carried it to him and claimed the promised reward. Henry laughing at the story paid the amount "with good grace."—Lord Dundonald, in his autobiography, says that once some ladies were being hoisted up the sides of a vessel by means of a chair suspended by a rope. Two or three had been safely deposited on deck, when, as the chair was just starting again, a parrot shouted out "Let go!" The sailors, thinking it the boatswain's order, dropped the rope, and away went the poor lady, chair and all, into the sea.

* The birds of prey do not deserve the name of "robbers." Their carnivorous propensities are only in accordance with their physiological structure, which de-

ful claws of the carnivorous mammals find their counterpart in the hooked beak and powerful talons of the carnivorous birds. The plumage of the sexes is usually unlike, and the offspring for two or three seasons resembles the mother-bird. The male of most species is smaller than the female, and not quite so plain in its color.

The order is thus tabulated into Families:

RAPTORES.	{	EYES DIRECTED FORWARD;	}	OUTER TOE REVERSIBLE.	Strigidæ,	<i>Owl.</i>
		EYES LATERAL; HEAD FEATHERED;		CLAWS SHARP.	Falconidæ,	<i>Hawk.</i>
		EYES LATERAL; HEAD NAKED;		CLAWS BLUNT.	Cathartidæ,	<i>Vulture.</i>

Strigidæ.*—The Owls comprise about two hundred species. The sexes are colored alike, and the mottled markings are nearly as apparent in the young as the old. Many species, however, are dimorphous (double form) in plumage.† So soft and downy are the feathers, that in its nocturnal foraging the owl's flight is noiseless as a shadow; while its acute sense of hearing detects the feeblest tread of a mouse. Living upon injurious vermin, it deserves protection from the ruthless war waged against it. The owl is the only bird that can bring both eyes simultaneously to bear upon an object.



Bubo virginianus,
Great-horned Owl. $\frac{1}{2}$.

mands animal food. Their place in the economy of nature is therefore as fixed as that of the animals on which they prey; and to associate with them notions of cruelty and rapine is unwarrantable and irreverent. They do not, it is true, charm our ears by their songs, nor delight our eye with their colors—for either would betray their presence to their victims and frustrate the design of their creation—but they faithfully perform their mission as scavengers. They also, like the carnivora generally, serve to prevent the undue increase of the Herbivora.

* This extensive family is cosmopolitan, several species being circumpolar, and at least two existing all over the world, unless Australia be an exception.

† Two young of the same sex in the same nest may start with different markings and retain them through life.

The *Great-horned Owl*, with a single exception, is the largest in the United States. It is often called the *Cat Owl*, as its tufts, erectile at will, give its head a sinister aspect not unlike that animal.

Falconidæ.—The *Falcons*, *Hawks*, and *Eagles* are included in this family. They are wont to dash their prey to the ground, and with their powerful talons* carry it to a quiet spot to eat uninterrupted; or, if too large to bear away, to gorge themselves and then retreat to some sequestered place for digestion.†

Fig. 225.

*Falco sparverius*, Sparrow Hawk. $\frac{1}{2}$.

Fig. 226.

*Astur atricapillus*, Goshawk. $\frac{1}{2}$.

The *Sparrow Hawk*, though one of the smallest, is a typical Falcon. So quickly does it close its wings when alighting

* When a Bird of Prey wishes to kill an animal with its claws it has only to rest down with its own weight, and the bending of the legs will thrust its talons deep into the flesh of its victim, (see Fig. 27).—The principle is illustrated in the roosting of a common fowl. When asleep it retains its hold of its perch by one foot, the other being drawn up under the feathers. Its grasp of the perch is involuntary, the muscles of the leg being so contrived that when the limb is bent the foot closes and remains so without any exertion of the will; and when straightened, the toes open and the hold is relaxed. A bird cannot keep its foot open when its leg is bent. This may be verified by watching a fowl walking. It closes its toes as it lifts its foot, and spreads them out again as they touch the ground.

† They then vomit forth, in rounded pellets, the indigestible bones and feathers which they have swallowed in their eager haste.

that they seem to disappear. It will often imitate the cry of a young bird, to call the old within its grasp.

The *Goshawk*, or Blue Hen Hawk flies low, until just over its prey, when it stretches down its powerful talons and catches it up, with hardly a deviation from a horizontal course.*

The *Caracara Eagle* of tropical America relishes

dead and living animals equally, and carries off its prey with either beak or claw.

The *Swallow-tailed Hawk* feeds upon reptiles and insects,† but never upon birds or quadrupeds.

The *White-headed Eagle* is the chosen symbol of our country.‡ It rises in the air by a series of spiral curves, and with an almost imperceptible motion of its wings, until it is a mere speck in the sky. Thence it

descends with lightning-like velocity. Its swoop is in a

* A Goshawk was once observed to dart with the swiftness of an arrow upon a flock of blackbirds crossing a river, and, giving five successively the death-squeeze, to return and pick them up one by one and bear them to the shore to be eaten at leisure.

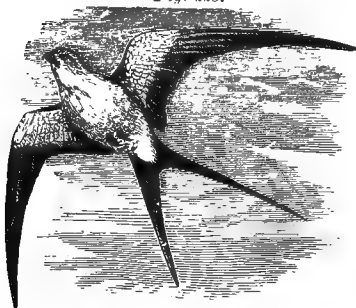
† Fond of wasps, it may sometimes be seen holding a nest in one claw and picking out the grubs with its bill. It has been known to pursue a swarm of bees, catching them with its claws.

‡ Equally indifferent to the extremes of heat and cold, as well as to a maritime or an inland life; now honestly pursuing an independent vocation, and anon acting the part of a freebooter and robbing the Fish-hawk of its well-earned food, it is not an altogether unsuitable emblem of the nation.

Fig. 227.

*Polybörus tharus*, Caracara Eagle. ♂.

Fig. 228.

*Nauclerus furcatus*,
Swallow-tailed Hawk. ♂.

cycloid, which is a line of swifter descent than a perpendicular, and also easier for alighting. To give a more powerful hold on the air when carrying its prey to its eyrie, its wings are hollow on the under side.

Fig. 229

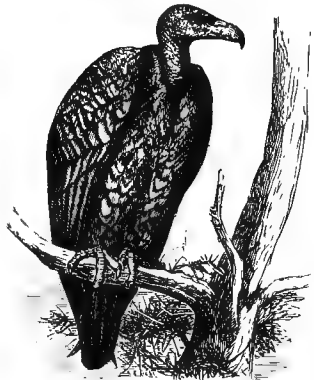


Haliaeetus leucocephalus.
White-headed Eagle. $\frac{1}{10}$.

Cathartidæ.* — The American Vultures being designed in the economy of nature to dispose of carrion, lack the powerful talons of the Falcons, but possess a strong beak for dismembering the dead bodies on which they feed. If one soaring aloft detects with its telescopic eye a carcass, the change of its flight from a circular sweep to a right line of descent is probably noticed by many

others too distant to be seen by the human eye, and thus a large flock quickly gathers from all quarters of the heavens.† The head and neck are bare of feathers, to enable them to be plunged deeply into a carcass. As the naked skin, however, would suffer in the cold upper air, the base of the neck is encircled with a ruff of soft down, arising from a loose fold, into which the neck and most of the head can be withdrawn, while the bird remains

Fig. 230.



Rhynogryphus aura,
Turkey Buzzard. $\frac{1}{3}$.

* Recent researches prove the Vultures of the Old and New World so osteologically different as to require the latter to be placed in a separate family, and the former to be degraded to the rank of a subfamily of the Falconidæ, the Vulturinæ.

† Both sight and smell seem to aid them in the pursuit of their food. The latter sense is remarkably keen, and they have been seen to descend directly from a great height in the air to putrefying food that was concealed from their vision.

in a semi-torpid state during the digestion of its over-gorged meal.

To this family belong the *California Vulture* (*Pseudogryphus californianus*), the *Black Vulture* (*Catharista atrata*), the *Turkey Buzzard* (*Rhynogryphus aura*) of the warmer regions of America, and the *Condor of the Andes*.

The last is typical of the family, and in size excels all except

the California Vulture. Its alar extent is about ten feet.* It will frequently soar for half an hour without once flapping its wings; but how it is accomplished has not been satisfactorily explained. To man, the Condor is inoffensive, nor does it often attack living prey.

Fig. 231.



Sarcorhamphus gryphus, Condor. $\frac{1}{16}$.

ORDER COLUMBÆ.

General Characteristics.—The Pigeons † have the bill shorter than the head, with the nostrils imbedded in soft skin; and the hind toe on a level with the others. Both male and female disgorge into the mouths of the young a milky substance, and, after a few days, macerated grain.

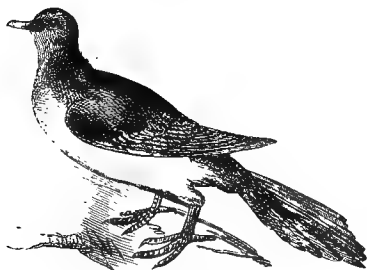
Columbidæ.—The *Wild or Passenger Pigeon* is common to all parts of North America. It frequently collects in such

* The exaggerated accounts of the earlier writers are to be accounted for by the fact that the Condor, when soaring at no great height from the ground, seems much larger.

† All the domestic varieties, now numbering nearly forty, are believed to have sprung from the Rock Dove (*Columba livia*) of Europe and Asia.

numbers as to load with nests every tree in a forest forty miles long. Each nest

Fig. 232.



Ectopistes migratorius,
Passenger Pigeon. $\frac{1}{2}$.

contains two eggs, hatching usually a male and female, which are believed to pair at maturity. The male often makes daily excursions of a hundred miles to procure food.* Many millions being thus congregated, it is astonishing how each bird in returning should go straight to its own mate and nest.

ORDER GALLINÆ.

General Characteristics.— This order includes the hen-like birds. They generally have feeble powers of flight,

* Their speed is very great. Pigeons have been killed near New York with their crops full of rice, which must have been eaten in the plantations of Georgia and Carolina, six or seven hundred miles distant. As they would digest grain in twelve hours, they must have traveled a mile per minute. They fly in enormous columns miles in length and width. It is estimated that such a flock would require millions of bushels of food each day. Audubon gives a vivid description of a resting-place on Green River, Kentucky. He says: "The noise which they made reminded me of a strong sea-breeze amongst the cordage of a ship. When they passed above my head I felt a current of air which astonished me. Thousands were already struck down by men armed with poles, but they continued to arrive without intermission. Fires were lighted. The birds precipitated themselves in masses, and pitched where they could, one upon the other, in large heaps like barrels. Then the branches gave way under the weight, cracked and fell, bringing to the ground and crushing the closely-packed flocks, which covered every part of the trees. It was a scene of tumult and confusion. In vain I tried to speak, or even to call the persons nearest to me. It was with difficulty that I could hear the guns fire, and I only perceived the men had fired by seeing them reload their arms. Pigeons continued to come, and it was past midnight before I noticed any diminution. The uproar continued all night. At last the day approached, the noise began to abate a little, and long before we could distinguish objects the pigeons commenced to start, and at sunrise all that could fly had disappeared. Now it was the wolves' turn, the howls of which saluted our ears. Foxes, lynxes, cougars, bears, rats, opossums, and martens, bounding, running, climbing, pressed to the quarry, whilst eagles and falcons of different species flew down from the air to take their part of such rich booty. The sportsmen then, in their turn, entered into the midst of the dead, the dying, and the wounded. The pigeons were piled in heaps, each took what he wished, and the pigs were left to satiate themselves on the remainder."

characterized by a whirring sound. To aid them in scratching, the hind toe is elevated. Their food is first softened in a crop, then mingled with the drink in a second expansion of the gullet, and lastly ground in the gizzard.* To elude

Fig. 233.



Argus giganteus, Argus Pheasant. $\frac{1}{2}$.

the sharp eye of their enemies, the Raptores, they squat upon the ground and lie quiet—their mimicry corresponding to the herbage they frequent. They are mostly polygamous,

* This is lined with hard cartilage, and is so strong and muscular as to pulverize glass and metals. The trituration of the food may be distinctly heard by standing beside fowls on their roost at night.

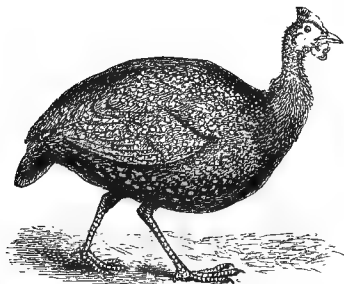
feeding in flocks of ten or twelve females to one male. As

Fig. 234.



Pavo cristatus, Peacock. $\frac{1}{2}$.

Fig. 235.



Numida meleagris, Guinea-fowl. $\frac{1}{2}$.

the female leaves her nest, her cackling is answered by the male, and thus she is guided to her companions.

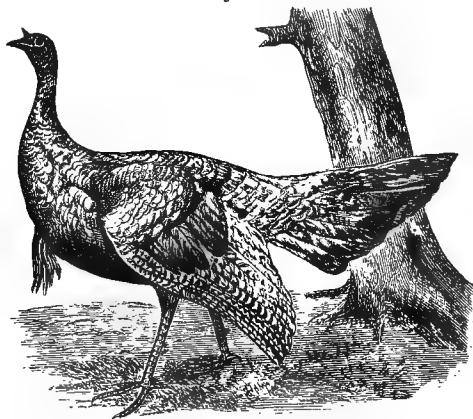
Phasianidæ.—The Pheasant is indigenous to Asia, but some species have become naturalized in the parks of European castles. The *Argus* has its secondaries, which are three times the length of the primaries, ornamented with rows of richly-tinted "eyes." Its tail has two feathers, so long that, while the bird is only the size of a common fowl, its extreme length is five feet.

Pavonidæ.—The *Peacock's* tail-coverts are decorated with "eyes." The true tail-feathers are short, unvariegated, and serve only as a support for the so-called "tail."

Numididæ.—The *Guinea-fowl* came from Africa. Its harsh, ringing cry of *camac, camac*, makes the bird very useful in the poultry yard as a protection from crows and hawks.

Meleagridæ.—The *Turkey* is indigenous to America. There is but one genus (*Meleagris*), with two species. One of these is the *M. ocellāta* of Honduras, whose tail is enamelled with blue “eyes,” each surrounded by a ring of yellow and purple. The other species has two varieties, the *M. gallopavo* and *M. mexicana*. The latter is the one from which

Fig. 236.

*Meleagris gallopavo*, Turkey. $\frac{1}{2}$.

the Domestic Turkey sprung. The Wild Turkey nests in some secluded spot, which it guards jealously, seldom approaching it twice by the same path, and luring the intruder away by various wiles. As soon as the young are hatched, the female takes them under her entire care, leading them long distances for food, and carefully avoiding marshes until her brood have exchanged their down for feathers impervious to water.*

Tetraonidæ.—The *Grouse* is distinguished by having the

* Turkeys are often captured in the following manner: A pen of logs is raised about four feet high. At one point an entrance is dug underneath and corn sprinkled both without and within. The Turkeys greedily picking this up enter the pen. Once entrapped, they vainly seek with elevated head to escape between the logs, but never think of stooping down to pass out where they entered.

tarsi and the nasal groove partly feathered.* Not being

Fig. 237.

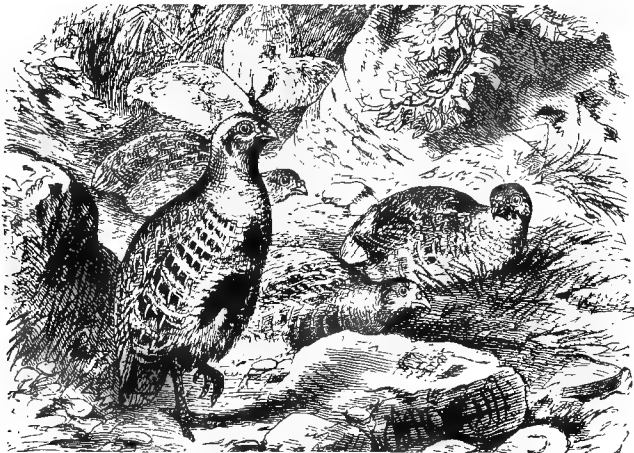


Bonasa umbellus,
Ruffed Grouse. ♂.

migratory, it is hunted during the colder months. In the spring, it drums upon a log with its wings, closely imitating distant thunder. When the young are hatched, they follow the mother, and the males joining the flock, all remain together during the winter, after which they separate, the young selecting their own homes, not far from their parents.

Perdiciidæ.†—The *Partridge* is not migratory, but passes the winter in swamps. Unlike the Grouse, it is monogamous, the young remaining with their parents till spring, and then pairing. At

Fig. 238.

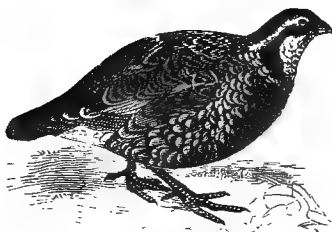


Perdix cinerea, Common Partridge. England.

* The Ruffed Grouse is called Partridge in New England and the West, and Pheasant in the Middle States.

† In New England the Perdiciidæ are called Quails. The true quail (*Coturnix*

Fig. 239.



Ortyx virginianus,
Bob-white or Quail. ♂.

Fig. 240.



Coturnix communis,
European Quail.

night, the whole covey roost on the ground in a close circle, their heads directed outward.*

ORDER BREVIPENNES.

General Characteristics.—The Short-winged birds are confined to the earth, and hence the wonderful muscular power in the fore limbs of other birds is in them transferred to the hind limbs. They have two or three toes, terminating in strong claws. The breast-bone is flat, and the pelvic bones are united in front.

BREVIPENNES. {	NOSTRILS AT THE BASE OF THE BILL.	Struthionidæ,	<i>Ostrich.</i>
	“ “ “ END OF A LONG BILL.	Apterygidæ,	<i>Apteryx.</i>

Struthionidæ.—The *Ostrich* is the largest living bird. Its bill is broad, its long tarsi are covered with scales, and large femur bones with voluminous muscles.

The *African Ostrich* stands eight to ten feet high, and is the swiftest-footed of all animals.† It is remarkable chiefly

communis) is found in the Old World and is migratory in habit, leaving Africa in the spring and returning from Europe in the autumn. Passing the Mediterranean in immense flocks, millions are captured as they alight upon the rocky islands.

* To this order belongs the Domestic Fowl (*Gallus bankiva*). The original stock, however, has been so modified by cultivation for thousands of years, that it cannot be identified though it is generally supposed to have come from India.

† The Ostrich will run thirty miles per hour. It is captured by the Arabs on their fleet steeds only after a chase of a day or two, by several relays of horses and

for its beautiful plumes, which have been prized as an adornment from time immemorial.

Fig. 241.



Struthio camelus, African Ostrich.

riders, and by pursuing in a straight line while the bird runs in a curve. One male accompanies two to six females who lay in one nest. The hens take turns in sitting during the day, thus enabling the others to travel the long distances necessary to get food in that desert country, without leaving the nest uncovered. The male assumes the task of incubation at night when his superior strength is needed to drive off prowling animals, which are sometimes found lying dead near the nest, killed by its powerful kick. As the young cannot for some time go far, or digest the hard food of the old ones, the females continue to lay extra eggs for their nourishment. In this entire system of incubation one can but see the nice planning of a Creator, fruitful in methods for meeting an end by varied means.—An Ostrich egg is equal to two dozen of those of the domestic hen. It is cooked by placing one end in the hot ashes and making a small orifice in the other, stirring the contents with a bit of stick till the omelette is roasted.—In Cape Colony there are now Ostrich-farms where these birds are reared for their plumes, which are plucked every eight months.

The *South American Ostrich* * is only about half as large as the African, but is more completely covered with feathers. It has three toes instead of two, and a larger hooked-spur on the end of the wings.

Fig. 242.

*Rhea darwini*, Patagonian Ostrich. $\frac{1}{3}$.

Fig. 243.

*Apteryx australis*, Apteryx. $\frac{1}{3}$.

Apterygidæ.—The *Apteryx* of New Zealand has stumps of wings and no tail. Its feathers look like fur. For incubation it digs deep holes in the ground, into which it flees when pursued—characteristics linking it to the lowest order of mammals.

ORDER LIMICOLÆ.†

General Characteristics.—The Plover-snipes have a long slender beak, without hard-cutting edges, and wholly or in great part membranous. Their narrow nostrils are placed low down, and entirely surrounded with soft skin.

Charadriidæ.—The Plovers frequent commons and unsheltered shores, running around in search of insects, slugs,

* It is also polygamous, the females laying their eggs scattered at random, which the male collects into a nest, and then broods, hatches, and even tends the young.

† The old order Grallatōres (waders) is now classed as three distinct orders, viz: Limicolæ, Herodiōnes, and Alectoridæ.

Fig. 244.

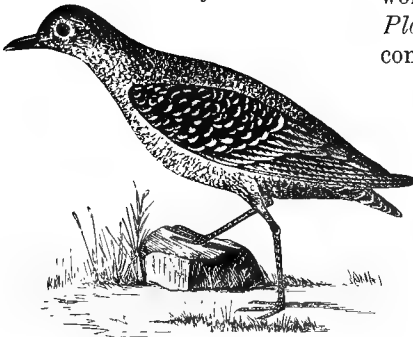
*Charadrius virginicus*, Golden Plover.

Fig. 245.

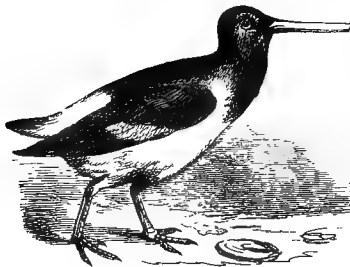
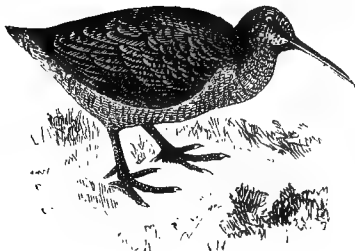
*Hematopus palliatus*, Oyster-catcher.

Fig. 246.

*Philohela minor*, Woodcock. †

worms, etc. The *Golden Plover* inhabits all the continent of America.

Hæmatopodidæ.—

The *Oyster-catcher* of the Atlantic coast has a bill, long, abrupt, and chisel-like, adapted to opening the shells of bivalve mollusks and detaching limpets from the rocks.

Recurvirostridæ.—

The *Avocet* possesses a recurved, flattened bill, useful for scooping up small fish and aquatic insects, as it sweeps the narrow runs, with a movement like that of a mower swinging a scythe.

Scolopacidæ.—The *Snipes* have long, grooved, flexible bills, well supplied with nerves to the end,

Fig. 247.

*Recurvirostra americana*, Avocet. †

that in probing deep into the bogs and moist turf, they may detect the worms and larvæ. Their upper feathers mimic well the herbage beneath them, and their eyes are placed so far back, that, like the Giraffe, their range of vision meets behind the head.

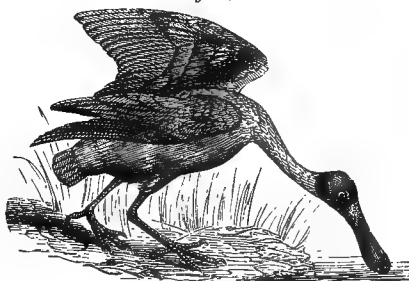
ORDER HERODIONES.

General Characteristics.—The Herons, Storks, Ibises, etc., are generally of large size, with long, S-bent necks, and tufts of matted feathers (powder-down) on both sides of the breast and rump. In flying, they double their neck and stretch back their legs. The latter serve as a rudder, their short tail being unfitted for this office.

Ciconiidæ.—The *White Stork* of Europe (see Fig. 253) is exceedingly useful, feeding upon garbage and noxious creatures. It is easily tamed, and its sagacity is marvellous.*

Plataleidæ.—The *Roseate Spoonbill* of the South is the only representative of this family in the United States. It breeds the second year, but does not attain its perfect plumage until the fourth or fifth. It is then a beautiful rose color, with carmine wing and tail-coverts, head naked with golden-yellow skin shading into glossy black around the top of the neck, and with patches of rich buff on each side of the breast and upper part of the tail.

Fig. 218.



Platalea ajaja, Roseate Spoonbill. 13.

* A tame stork has been known to join children playing hide and seek, run when touched and to distinguish the child whose turn it was to pursue the rest so well as to be on its guard along with the others. The Germans and Dutch esteem it a good omen when a stork builds its coarse nest of sticks on their house-top. Innumerable stories are current among different nations, ascribing to the stork gratitude, chastity, parental affection, conjugal fidelity and filial piety. In the Tyrol, for example, a male stork refused to migrate, and passed several winters with his mate, who, being wounded, could not fly.

Ardeidæ.—The *Great Blue Heron* has a sharply-pointed, stout, conical-shaped bill, in striking contrast with that of the Spoonbill, though they associate together, and often nest upon the same tree.

Fig. 249.

*Ardea herodias*, Great Blue Heron. $\frac{2}{3}$.

Fig. 250.

*Tantalus loculator*, Wood Ibis. $\frac{1}{8}$.

Tantalidæ.—The Ibis inhabits all parts of the world, and some species migrate so irregularly as to be nowhere at home. Its long, arcuate bill is adapted to rooting in the mud in search of worms and small insects.* The *Wood Ibis* has a strong bill, with which it strikes the fish, frogs, young alligators, and snakes that come to the surface on being disturbed by the bird's dancing about in the water.†

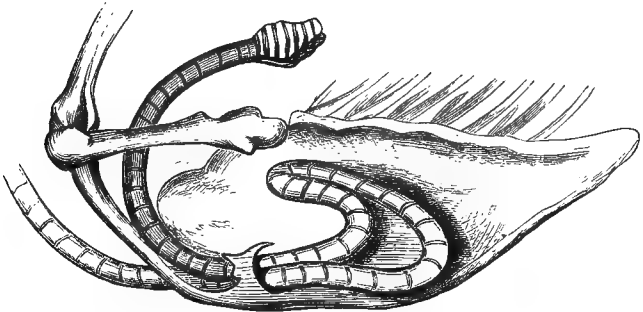
* The Sacred Ibis (*I. religiosa*) was venerated by the ancient Egyptians, probably because it rid them of serpents, the skins and scales of which have been found in the Ibis mummies. Some think, however, that the reason of this worship was merely because the coming of the bird was simultaneous with the annual overflow of the Nile, and hence symbolical of fertility. Whoever killed an Ibis was mobbed while the dead bird was embalmed. The Ibis multiplied in consequence to such an extent as to impede travel in the streets. The affection of the bird for Egypt was so great that, according to Acteon, when taken away it died of home-sickness. But now, being killed and eaten by the modern inhabitants, who have abandoned the faith of their fathers, it has almost deserted the country.—(*Figuiet*.)

† When a sufficient number of its victims lies floating around it gorges itself, often leaving many untouched, and then, stationed on the margin of the stream with its breast turned towards the sun, patiently awaits the process of digestion.

ORDER ALECTORIDES.

Gruidæ.—The *Whooping Crane* (see Fig. 253) is principally confined to the Mississippi Valley. It seeks its food in

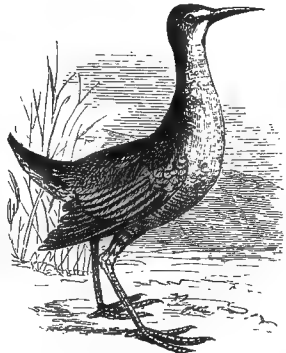
Fig. 251.

*Convoluted Trachea of the Crane.*

the wild uplands, feeding upon insects and plants. About thirteen inches of the windpipe are twisted up in a hollow of the breast-bone, thus giving to the voice a sonorous, trumpet-like tone.

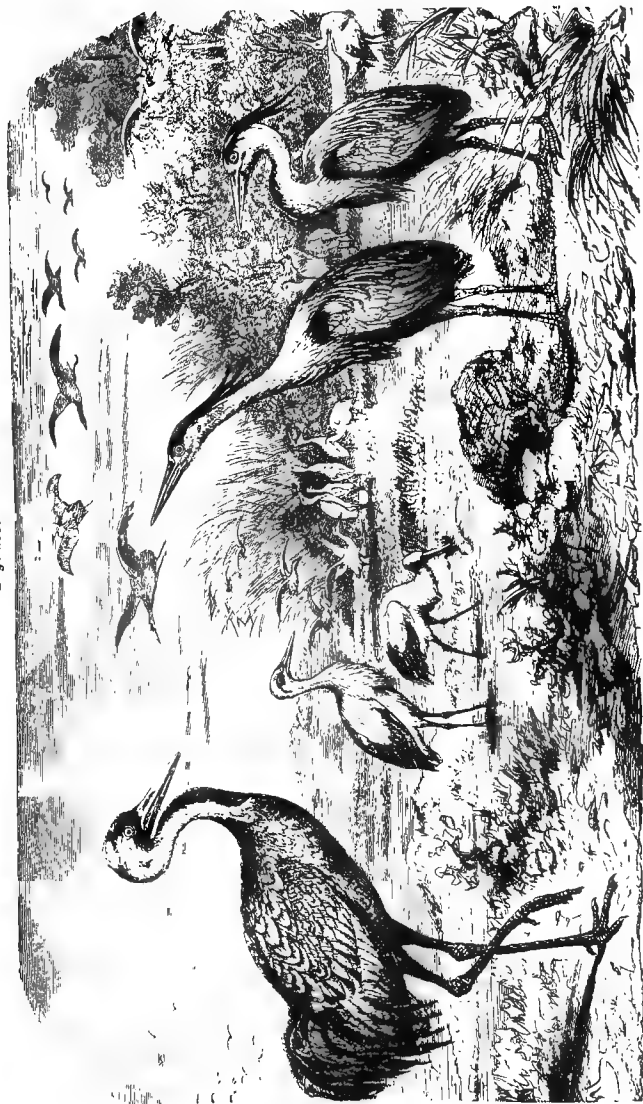
Rallidæ.—The Rails have more or less pervious nostrils; long, slender toes; a compressed body and short tail. The *Virginia Rail** is a type of the genus *Rallus*, which contains about twenty species. The *Purple Gallinule*, abundant in the Southern, but accidental in the Northern

Fig. 252.

*Rallus virginianus*,
Virginia Rail. $\frac{1}{2}$.

* Except in being smaller it is almost identical in form and color with *R. elegans*, thus showing the value of size as a specific and distinctive character.

Fig. 255.

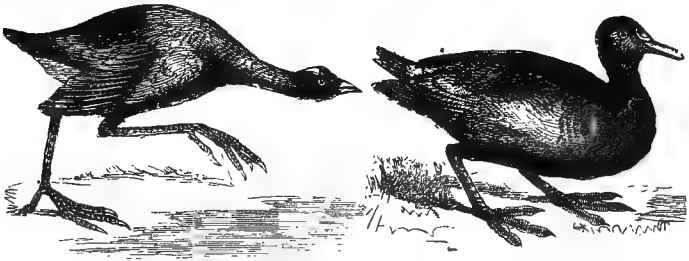


1. *Grus americana*, Whooping Crane. 2. *Ciconia alba*, White Stork. 3. *Ardea cinerea*, Common Heron.

States, has a rich and variegated plumage. It seeks its food of larvæ, weeds, and grains, upon the surface of the water only, its compressed body and large feet enabling it to thread its way among aquatic stems and to walk upon floating

Fig. 254.

Fig. 255.

*Gallinula martinica*, Purple Gallinule. †.*Fulica americana*, Coot. †.

plants. The *Coot*, with its lobed feet, is adapted to a more exclusively aquatic life, and hence, swimming and diving with great address, it is seldom seen on the land.

ORDER LAMELLIROSTRES.*

General Characteristics.—The Geese, Ducks, etc., have palmate feet and lamellate bills, with corresponding lacinate processes on the sides of a fleshy tongue, ending in a horny tip.

LAMELLIROSTRES.	{	LEGS VERY	{	TIBIA MOSTLY BARE.	Phœnicopteridæ, <i>Flamingo</i> .
		LONG,			
		LEGS SHORT,		TIBIA FEATHERED.	Anatidæ, <i>Duck</i> .

Phœnicopteridæ.—The *Flamingo*,† when feeding, lays the upper part of its bill next the ground, and with its feet stirs up the mud for small fish, insects, and seeds, which it

* The old order Natatores (swimmers) has been broken up by recent ornithologists into five distinct orders, viz: Lamellirostres, Steganopodes, Longipennes, Pygopodes and Sphenisci.

† The flamingo, with its heron-like legs but full-webbed toes, eases the transition from the waders to the swimmers. So many of its characteristics are common to both, that it has been tossed back and forth from the days of Linnæus to the present, nor is it certain where it will be allowed to rest.

secures by straining through its lamellæ.* Its plumage is a

Fig. 256.



Phenicopterus ruber, Flamingo. †.

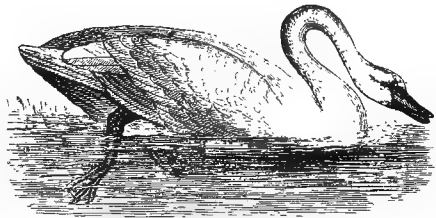
deep scarlet on the back, and roseate on the wings. It builds a hillock of mud as high as its body, and on the top makes its nest and lays its eggs, its long legs hanging down on each side.

Anatidæ.—The *Ducks* have the legs short, with the hind toe separate, and the bill covered with soft, sensitive skin, and highly lamellated, to filter the ooze in which they feed. They are close-feathered,

and keep the plumage well oiled, so as to dive without getting wet.

The *Swan's*† neck, unlike the Flamingo's, is in no proportion to the length of its legs, but is adapted to a swimmer that never dives, yet feeds upon aquatic roots. The stroke of its wing is powerful enough to frac-

Fig. 257.



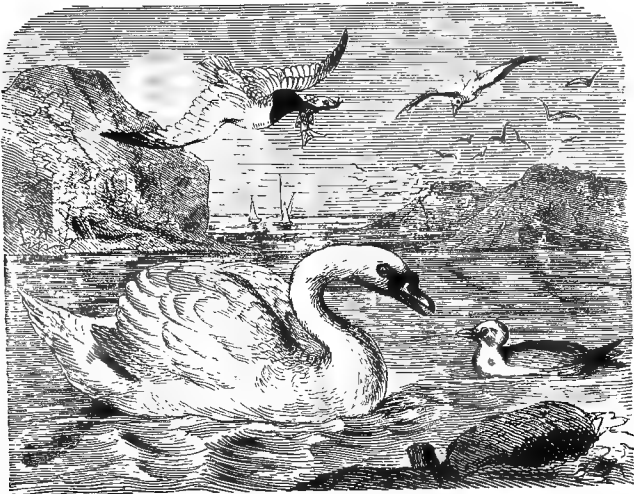
Cygnus buccinator, ‡ Trumpeter Swan. †.

* Its tongue is very fleshy, and, during the days of Rome's extravagance, her gluttons were wont to parade a dish composed of flamingoes' tongues.

† The two species of Swans in America are easily distinguished, the *Cygnus buccinator* not having the orange or yellowish spot in front of the eye which is so characteristic of *C. americanus*.

‡ The voice of *C. buccinator* is remarkably raucous in comparison with that of *C. americanus*, though each has the convolution of the trachea in the keel of the sternum, like that of the whooping-crane.

Fig. 258.

1. *Larus atricilla*, Laugbing Gull.2. *Cygnus olor*, Mute Swan.

ture a man's leg.* Swans fly high in their migration, to keep "the sky" of rapacious birds. They are said to live a hundred years.

The *Canada Goose* in the spring migrates in great numbers to the north to breed, and returns to the tropics in the autumn. It always flies in flocks, having the form of an acute angle, the leader falling back when fatigued, and the next one taking its place. The sexes are distinguished by the greater length of the male's neck. They are monogamous, but are supposed to pair anew every spring.

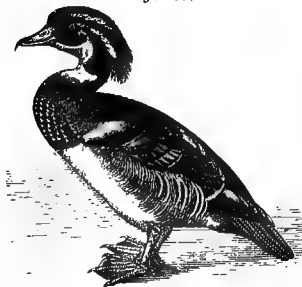
* This is explained by its swiftness, on the mechanical principle that the effect increases as the square of the velocity.

Fig. 259.



Branta canadensis,
Canada or Wild Goose. $\frac{1}{10}$.

Fig. 260.

*Ayya sponsa*,Wood or Summer Duck. $\frac{1}{10}$.

Arctic regions, occasionally migrating to the middle Atlantic coasts.* The dark, rock-colored hue of the females is an excellent mimicry, and they will remain on the nest till trodden upon.

The *Goosander* † has a narrow, cylindrical bill, with a saw-like margin, the teeth pointing backward, and the tip armed with a hooked nail. It swims wholly submerged, seizing fish, whose very struggles force them more readily into the gullet of their captor. ‡

* It breeds upon the cliffs, and the down with which it lines its nest has great commercial value. It is obtained by robbing it two or three times a season, the male at last supplying the deficiency from his own breast.

† This is one of the species of Ducks popularly called Mergansers or Sheldrakes.

‡ Sometimes the fish is so long

The *Wood Duck* nests in hollow trees, sometimes twenty feet above the ground, and six feet below the opening. For lining, it uses down from its own breast. As soon as the whole brood of twelve or fifteen are hatched, the mother takes them by the wing or back of the neck, and depositing them on the ground, hastens with them to the water.

The *Eider Duck* inhabits the

Fig. 261.

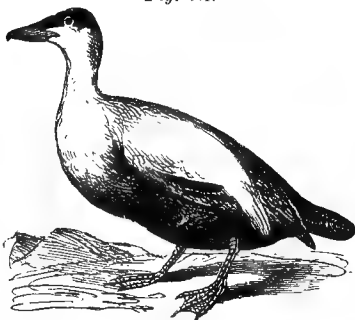
*Somateria mollissima*, Eider Duck. $\frac{1}{10}$.

Fig. 262.

*Mergus americanus*, Goosander. $\frac{1}{10}$.

ORDER STEGANOPODES.

General Characteristics.—The Foot-covered birds are readily recognized by the totipalmate feet and unfeathered gular pouch—a sac beneath the bill sometimes holding a gallon, and used for a temporary larder.

Pelecanidæ.—The *White Pelican** swims upon the surface, darting down its long bill at the fish swimming near, till its pouch is filled, when it retires to the sand-banks and stands with its fellows in long rows, while the contents of the sac gradually pass into the stomach, as the process of digestion goes on.

The *Brown Pelican* flies ten to twenty feet above the surface, watching the shoals of fish beneath, till a chance offers, when it falls flatwise, often with a force that immerses the whole body,† scooping up one or more with its pouch. Then rising, it repeats the operation as often as the capacity of its pocket will permit.

Graculidæ.—The *Cormorant* ‡ pursues its prey under the water, using its wings to increase its speed. It is fond of eels, but often has a hard battle to keep one down, sometimes struggling for half an hour, and then taking it to a rock and

Fig. 263.



Pelecanus fuscus,
Brown Pelican. 1/16.

that the tail projects and it can be introduced fully into the stomach only after the head has been digested.

* The White Pelican (*P. erythrorhynchus*) ranges from Florida to the northwest coast. The Brown Pelican (*P. fuscus*) from the coast of North Carolina around to California. The former is remarkable for a horny excrescence on the top of the upper mandible.

† This dash upon the water would be fatal to itself if it were not for a thick layer of air-cells just beneath the skin, which breaks the force of the blow.

‡ Cormorants are abundant in all parts of the world, and by the Chinese are tamed and used for fishing, by placing a ring at the base of the neck to prevent the bird from swallowing the game.

thrashing it till disabled. Its iris is bright green, and its plumage well oiled and glossy.

Fig. 264.

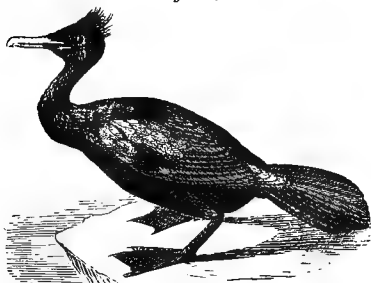
*Graculus carbo*, Cormorant. $\frac{1}{2}$.

Fig. 265.

*Plotus aninga*,
Snake Bird or Water Turkey. $\frac{1}{2}$.

Plotidæ.—The *Snake-bird* is found throughout our Southern coasts. It is adapted to catching its prey under water, either by impaling upon its sharp, pointed beak, or by seizing between its serrated mandibles. Its favorite position is just above the water, into which it drops head first, so quietly as to make scarcely a ripple. Swimming beneath till it finds tufts of reeds, perhaps a thousand feet away, it shows at the surface only its bill and eyes, as it reconnoitres the neighborhood. The crimped tail-feathers serve as a rudder, but the wings are not used in swimming.*

ORDER LONGIPENNES.

General Characteristics.—The Long-winged birds are distinguished by the size of their pointed wings and their palmate feet, with free, elevated hind toe. Generally oceanic, they rest upon the water, but do not dive.

LONGIPENNES.	{	NOSTRILS NOT	}	HALLUX SMALL.	Laridæ,	Gull.
		TUBULAR;				
	{	NOSTRILS	}	HALLUX RUDIMENTARY	} Procellaridæ,	Albatross.
		TUBULAR;				

* Even before the young leave the nest a parasitic worm is found in their stomach, which works its way to the brain, and there thrives in clusters of ten or

Laridæ.—The Gulls are cosmopolitan and the true scavengers of the ocean. The *Great Black-back* is typical of those which visit the Atlantic coast. It feeds upon fish, and sometimes upon small birds or quadrupeds. The *Skua* is remarkable for its stout, cored bill, hooked upper mandible, and piratical habits. Like the White-headed Eagle among the Fish-hawks, it pursues birds of its own family, and forces them

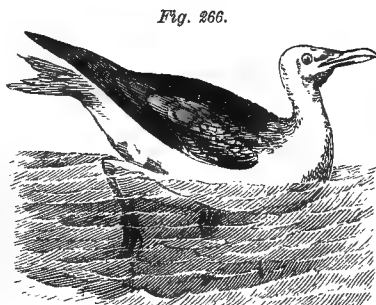


Fig. 266.

Larus marinus, Great Black-backed Gull. $\frac{1}{4}$.

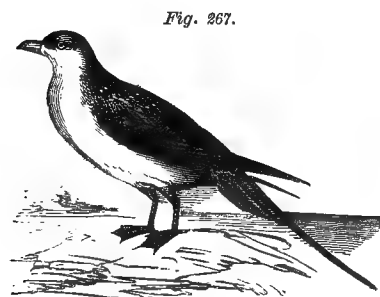


Fig. 267.

Stercorarius parasiticus, Arctic Skua. $\frac{1}{5}$.

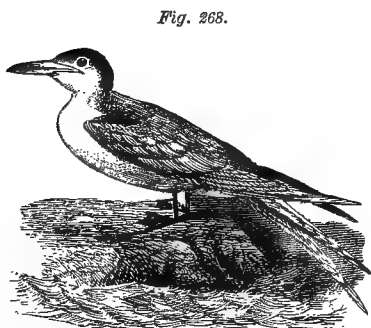


Fig. 268.

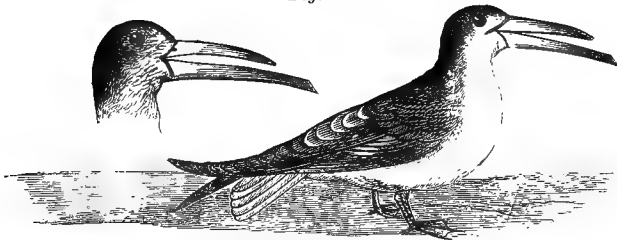
Sterna wilsoni, Wilson's Tern. $\frac{1}{4}$.

to give up their booty; and sweeping down with the velocity of an arrow, catches it before reaching the water. The *Tern* has long, pointed wings, a forked tail, and slender, straight bill. The graceful evolutions of this "Swallow of the Sea," as it skims along the surface, are a perpetual delight to the observer. The *Scissors-bill* has its long, lower mandible compressed laterally to the shape and sharpness of a knife-blade,* while it shuts into the grooved edge of

more. Nine-tenths of adult specimens are thus infested, and yet are in apparently good health.

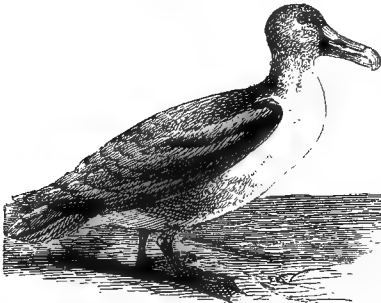
* This cultrate edge is specially useful in cutting off the contractor

Fig. 269.

*Rhynchops nigra*, Scissors-bill. $\frac{1}{2}$.

the short upper one, like a razor into its handle.

Fig. 270.

*Diomedea exilans*, Wandering Albatross. $\frac{1}{10}$.

Reposing on the surface of the water, with its head under its wing, it is often found a thousand miles from land. Once elevated in the air, it seldom flaps its wings, and

muscle of the oyster and other bivalves which the scissors-bill finds a little open on the beach.

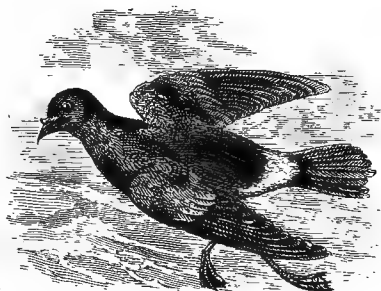
* In the swiftest swallow the expansion of wing is twice the length of the body; but in the scissors-bill it is much greater, giving corresponding increase of power.

Darting swiftly* along, cutting the water with its lower mandible, small fishes struck by it slide upward to the throat, and are immediately swallowed.

Procellariidæ. — The Albatross and Petrel are characterized by a hooked bill and nostrils united in a double-barrelled tube. The *Common Albatross* is

the largest sea-bird, having an expanse of ten to fifteen feet. Reposing on the sur-

Fig. 271.

*Thalassidroma pelagica*, Stormy Petrel. $\frac{1}{3}$.

yet ascends or descends apparently without an effort.* The *Petrel*, sometimes called Mother Carey's Chicken, is especially dreaded by sailors as the harbinger of a storm.†

ORDER PYGOPŌDES.

General Characteristics.—The “Rump-footed” birds have the tibiæ buried in the body nearly to the heel. This prevents walking, but favors swimming. Their feet are lobate or palmate, and their plumage is glossy.

PYGOPODES.	{	FEET FOUR-TOED, PALMATE;	{ HALLUX LOBATE CONNECTED.	Colymbidæ,	<i>Loon.</i>
		FEET FOUR-TOED, LOBATE;	{ HALLUX LOBATE FREE.	Podicipidæ,	<i>Grebe.</i>
		FEET THREE-TOED, PALMATE;	{ HALLUX ABSENT.	Alcidæ,	<i>Puffin and Auk.</i>

Colymbidæ.—The *Loon*, or Great Northern Diver, in its mature plumage of the fourth year, has few rivals in beauty. Unable to move on land, except by a constant succession of awkward tumbles, in the water it is a rare swimmer and diver. Usually floating about half submerged, it can at pleasure settle down, showing only its head, or entirely sink and, escaping with great swiftness, rise far distant.‡

Podicipidæ.—The *Grebe*§ has its toes partly separate and flat, the



Colymbus torquatus, Loon. †.

* It is found south of the equator, but there are other species on the western coast of North America.

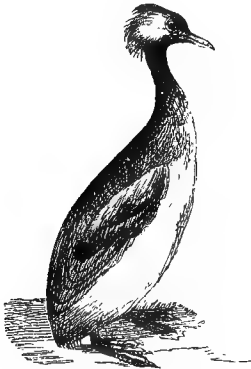
† Gleaning its scanty pittance from the whirling surges of the sea and making its appearance in great numbers just before a storm, seeking food and shelter in the wake of the vessel, it has been charged with creating the tempest.—Its flesh contains much oil and the natives of the Faroe islands are said to make a lamp by drawing a wick through the body of a very fat one, and lighting the end which projects from the beak.

‡ Its cry is somewhat like the howling of a wolf, and is thought to portend rain.

§ The Grebe, the Auk and other aquatic birds are a source of revenue to the people inhabiting the rocky coasts, which they frequent in multitudes. The nests

edges being furnished with a broad, stiff membrane, making each one a paddle. On the land, not being able even to tumble, like the loon, it lies down and pushes itself along by its feet. In the water, however, it is perfectly at home, diving and using its wings in pursuit of fishes and aquatic insects.*

Fig. 273.



Podiceps cornutus,
Crested Grebe. $\frac{1}{3}$.

Fig. 274.



Fratrcula arctica,
Puffin, Arctic Regions. $\frac{1}{2}$.

Alcidæ.—The Puffin and Auk† have three toes fully webbed, short wings, and a general adaptation to a purely aquatic life. On the land they sit upright. Most species pluck out feathers to bring their eggs into immediate contact

are often built in the ledges of inaccessible cliffs, but the hardy fowlers suspend themselves by stout ropes from the summit of the precipices, and by swinging to and fro reach every cranny and crevice of the rock, gathering eggs and young birds. The calling is a perilous one. Often the rope chafes against a projecting edge of the rock, or vertigo seizes the fowler, or he reaches too far, or slips from his footing. The men holding the rope above hear a shriek of despair, and then all is still save the roar of the remorseless waves below.

* Singularly enough, the stomach of the Grebe always contains a mass of its own feathers, involuntarily swallowed, probably in dressing and cleansing its plumage.—One species makes a floating nest upon which it sits and hatches its progeny. But if disturbed, it plunges one foot into the water and, employing it as an oar, transports its dwelling from the threatened danger.

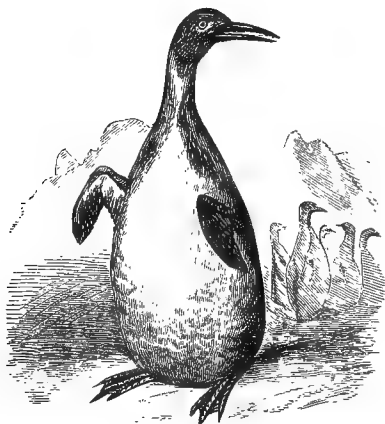
† The Great Auk (*Alca impennis*) is said to have become extinct within the last half-century. A high value is placed upon the few specimens which have been preserved, there being now known only thirty-four birds and forty-two eggs.—(Wood.)

with their flesh, for greater warmth during incubation. The Puffin drives rabbits from their holes, or burrows to the depth of two or three feet to lay its single egg, while the Auk deposits its two eggs upon a rocky shelf in the side of a cliff overhanging the sea.

ORDER SPHENISCI.

General Characteristics.—The *Penguin* is half fish and half bird in its habits. It has paddle-wings, with short, rigid, scale-like feathers, disposed in regular order, and is incapable of flight. Its bones are dense and heavy, with no apertures for

Fig. 275.



Spheniscus demersus, Jackass Penguin. 10.

the admission of air. It usually keeps near the land, but seldom visits it, except for nesting. Whole companies then sit erect along the shore, where they might easily be “mistaken for a party of choristers with surplices and black gowns.” The Penguin is confined to the colder regions of the South,* as the Puffin and Auk are to those of the North.

* The Patagonian Penguins are said to collect in such numbers at breeding-places as to cover thirty or forty acres. The ground is laid out in squares for their nests,

MIGRATIONS OF BIRDS.

Many species of birds leave certain localities in the fall, and, spending the winter at the South, return in the spring. Why they do thus has never been satisfactorily explained. The failure of food in rigorous climates is, without doubt, the main factor in the solution of the problem, but it is by no means the only one. Birds might incubate in warm latitudes as well as in cold; unless, perhaps, a second factor be found in the physical necessity of maintaining a uniform temperature. But individuals of many migratory species remain in the region of their nativity with no apparent inconvenience. Greater freedom from molestation in rearing their broods has been suggested as a third factor. If it be so, then all southern birds should come north. Some birds return, year after year, to the same localities, as proved by tying bits of red silk to their legs; but it cannot be positively asserted of many species. The southernmost limits of some individuals of a species may also be the northernmost limits of others, so that the species may be regarded as resident, though the individuals are migratory.

The males of some of the Thrush family, as well as those of certain species of other families, in migrating northward precede the females by two or three weeks, while the sexes associate in going southward.

It is not determined whether any of the northern birds migrate as far as the Equator, though many individuals of most of the species are known not to pass beyond the Gulf States, especially the southern half of Florida. The strictly insectivorous birds, as swallows, martens, etc., collect in flocks and leave earliest in the fall. They are followed by the granivorous when seeds become scarce or covered with snow.

Extensive districts become gradually depopulated of certain species, while in other regions they multiply. After a time the former localities are revisited by the species that had become nearly or quite extinct, while the latter lose their abundance. Hence, to the annual migrations must be added others marked by cycles of years; and not necessarily in lines of longitude, but as frequently in those of latitude.

Birds come and go; but whence they come and whither they go is a matter of conjecture. One morning the trees of Independence Square, in the heart of Philadelphia, were found filled with crows. Not a caw was to be heard nor a movement seen. The birds appeared to be awaiting in silence further instruction. After some time several new-comers glided among them, threading their way through all the flock, when suddenly the teeming thousands rose simultaneously and departed as mysteriously as they came.

as accurately as if a surveyor had been employed; stones are removed, streets made, a wall is thrown up on the windward side, and sentinels are posted.

HINTS FOR PRESERVING SKINS OF MAMMALS AND BIRDS.

Mammals.—Stuff cotton into the mouth, nostrils, large shot-holes, etc. Split the skin from the top of the breast-bone to the tail, being careful not to cut through the abdominal muscles. Push off the skin, not pull it off from the body. Separate the limbs from the body, preserving all the bones, including the shoulder-blades. With a cleft stick slide out the tail, if covered with hair ; but, if naked like the tail of a rat, cut it off, as it cannot be skinned. Turn out the legs and clean away all flesh to the toes, leaving the tendons around the joints. Skin over the head, taking off the ears close to the skull, and preserving uninjured the eyelids and lips. Cut into the mouth on the inside of the teeth only to remove the tongue. Cut off the head, cleaning away all muscle and taking out the brain and eyes. While the skin is wrong side out and moist, sprinkle it thoroughly with a mixture of equal parts, by weight, of powdered alum and arsenic. Fill the eye-orbits with cotton. Push the skull and legs back, supplying the place of the flesh in those portions with tow or cotton. Force a wrapped wire into the tail, if skinned, to hold it in place. Leave the skin a few hours, flattened to bring the inner surfaces together, to absorb the mixture. Finally, distend the skin, without stretching it, into its natural shape, as nearly as possible, with any dried vegetable substance.

Birds.—Take the girth of the body over the wings with a slip of paper, pinning it in the form of a ring, and slide it off over the tail. Begin the incision with the lower third of the breast-bone. Cut off the legs at the knee-joint, and the wings at the elbow-joint. Skin over the head to the bill, pulling out the ears and enlarging the orifice to take out the brain by cutting forward into the roof of the mouth. In all other respects proceed as with Mammals, with such slight modifications as will naturally suggest themselves. Most web-footed birds have the head too large to force the skin over. For these, skin the neck as far as possible, amputate, and after the skin is poisoned and turned back, an incision must be made on the top of the head or under the throat, by which the head may be skinned in the usual way. Then poison, turn back, and carefully sew up the incision. Great care must be taken to work the poison around the roots of the tail and the wrist-bones of the wings, opening orifices on the inside with the blade of the knife, and inserting a pinch of the powder. In the case of very long wings, after turning the skin back, cut a slit along the under-side of the arm and remove the muscles. Stuff cotton loosely into the neck and body and around the bones of the legs. Tie the bones of the wings in their natural position. Sew up the slit, and after a careful

arrangement of any displaced feathers, place the bird in the paper ring, and label. Upon the label should be written the scientific and the local name ; the length in inches, from tip of beak to tip of tail, the bird lying on its back with neck not stretched ; length of wing from carpal joint to tip of longest quill ; and of tail from insertion to end ; the sex ; kind of food found in the stomach ; locality ; date ; and the name of the collector. To remove blood, wash freely with warm water and dry immediately by dusting on finely powdered plaster of Paris or chalk ; also sprinkle on the chalk or plaster if fat annoys while skinning. Oily stains may be removed from feathers by a solution of potash or soda (half a teaspoonful to a cup of water), and washing immediately after with pure water and drying with plaster. If the feathers to be cleansed are colored, ox or sheep's gall, diluted one-half with water, should be used instead of the potash or soda. Single feathers, permanently bent, may be at once restored to their natural position by simply holding them in a jet of steam issuing from the spout of a tea-kettle. For study, unmounted specimens of birds or animals are always preferred ; and as mounting is a distinct art from simply preserving, and can be learned only from a teacher, no attempt is made to give instructions in it.

Eggs should never be washed, even to remove the filth of the nest. A dentist's tooth-drill or a nail filed three-cornered may be used for drilling a hole in the side. By inserting a small glass tube or straw the contents may be blown out of the same hole, around the tube. Blowing in a little water and shaking thoroughly will often facilitate the process. If the embryo is partly developed, a larger hole may be cut, and the contents removed with a hooked pin, pulling out one limb at a time, and cutting it off. The operation of blowing eggs should always be performed over water. Labels for eggs should note particularly the date, locality, site chosen by the bird, scientific and common name, and any facts of interest.



CLASS III. REPTILIA.

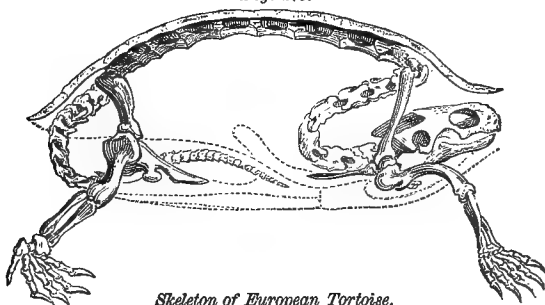
General Characteristics (see Table, p. 13).—Reptiles*, being cold-blooded, require nothing to retain the heat, and so are covered only with naked skin, scales, etc. The three-chambered heart does not send all the venous blood to the lungs. Pure oxygenated blood, however, goes to the head. Reptiles are most abundant in hot climates, those of cold regions hibernating. They are generally carnivorous, and swallow their prey whole.

REPTILIA. Body	{	NEARLY COVERED WITH A BONY OR HORNY CASE WHICH BLENDS WITH THE NEURO-SKELETON.	}	Testudinata, <i>Tortoise, etc.</i>		
		COVERED WITH SQUARE PLATES. .	}	Loricata, <i>Alligator, etc.</i>		
		COVERED WITH IMBRICATE SCALES;	{	MOUTH NOT DILATABLE; LEGS GENERALLY DEVELOPED, EYES WITH LIDS.	}	Lacertilia, <i>Lizard, etc.</i>
			{	MOUTH DILATABLE: NO LEGS, NO EYE-LIDS.	}	Ophidia, <i>Snake, etc.</i>

ORDER TESTUDINATA.

General Characteristics.—The Turtles have the skeleton on the exterior of the body. The vertebræ and ribs are

Fig. 276.

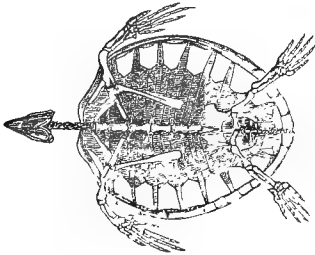


Skeleton of European Tortoise.

* There seems little resemblance between a crawling reptile and a fitting songster; yet, in structure, reptiles are much nearer related to birds than to mammals. This is shown especially in the fossil, reptile-like bird, *Archæopteryx*, and the bird-like reptiles, *Dinosauria* and *Ornithosauria*. See Geology, page 183-5.

consolidated into an upper shell called the *Carapace*, while the broadened sternum forms a lower one termed the *Plastron*.*

Fig. 277.



Skeleton of a Marine Turtle.

Into this portable castle the reptile retreats with marvelous rapidity,† in one genus the limbs and head being withdrawn so as to show no apparent opening. The viscera, the shoulder and hip-bones, and the muscles are all packed in the thorax. Breathing is performed by enlarging the cavity of the mouth, when the air rushes in through the nostrils, and by contraction is forced down the windpipe.

nostrils, and by contraction is forced down the windpipe.

TESTUDINATA Feet	TRUNCATED AND UNITED TO THE NAILS.	}	Testudinidæ, <i>Cistudo virginiana</i> , <i>Box Tortoise</i> .		
			FLATTENED, WITH DISTINCT TOES.	{	CARAPACE COVERED WITH SCALES
	CARAPACE COVERED BY A FLEXIBLE SKIN.	Chelydidæ, <i>Chelys matamata</i> , <i>Bearded Tortoise</i> .			
	FLATTENED AND FORMED INTO PADDLES FOR SWIMMING, WITH TOES CONCEALED.	}	Trionychidæ, <i>Trionyx ferox</i> , <i>Snapping Tortoise</i> .		
Chelonidæ, <i>Chelonia midas</i> , <i>Green Turtle</i> .					

Testudinidæ.—The Land Tortoises † have feet formed only for walking, and hence they never enter the water. Their food consists of soft plants, as mushrooms. The plastron of the female is convex, and that of the male concave. §

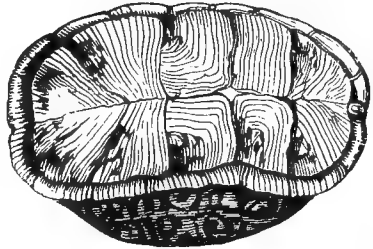
* The same number of pieces is found in the skeleton as in the ordinary vertebrates, the shape and size alone being changed.

† The long, slender muscles which move the flexible neck are tied to the under side of the carapace. When dried they may be capable of producing musical sounds and thus have given rise to the poetical legend of the origin of the lyre.

‡ Many authors use the terms tortoise and turtle synonymously; but the former term is properly applied to the land species, and the latter to the marine.

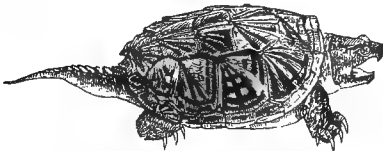
§ The "Gopher," a small tortoise about eighteen inches long, found at the South, belongs to this family. It will burrow six feet in the ground.

Emydidæ.—The *River Tortoise* is a common North American species. Its sharp-edged jaws are strong enough to bite asunder a stick half an inch in diameter. It is fond of water-fowl, swimming beneath the surface and quietly dragging them under. About June 10th, in the temperate climates, it



Cistudo virginiana, Box Tortoise. $\frac{1}{2}$.

Fig. 279.



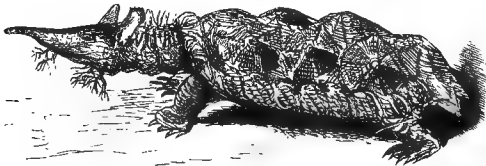
Chelydra serpentina,
River Tortoise, "Snapping Turtle." $\frac{1}{2}$.

lays thirty to fifty spherical eggs. For their reception, a hole is scooped in the sand by the hind feet, and then smoothed over and left. This entire work is done within fifteen or twenty minutes. The eggs are hatched by the heat of

the sun in about three months, when the young immediately take to the water.

Chelydidæ.—The *Bearded Tortoise* is at once the type

Fig. 280.



Chelys matamata, Bearded Tortoise, South America. $\frac{1}{2}$.

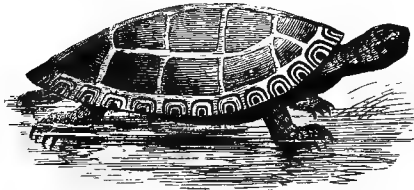
and the grotesque member of this aquatic family. Its flesh is highly prized.

Trionychidæ.*—The *Fierce Trionyx* is destructive to

* For an interesting account of the great fresh-water tortoise read Bates's "The Naturalist on the Amazon."

fish, smaller quadrupeds, birds and reptiles. One bite of its formidable jaws will sever the fingers from the hand or the toes from the foot. Its eggs have brittle shells.

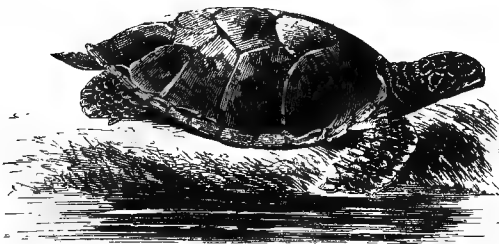
Fig. 281.



Triönya ferox, Snapping Tortoise. $\frac{1}{2}$.

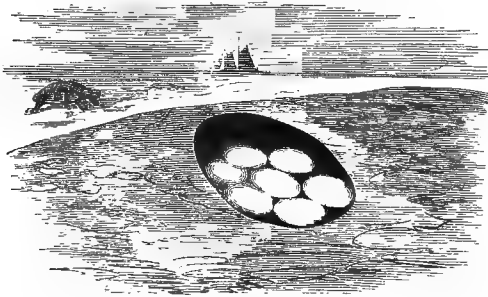
Chelonidæ.—The Sea Turtles are provided with flippers, and venture far out from land, visiting the shore only at stated places and times to lay their eggs. They frequent the tropical waters in herds.* The *Green Turtle* is the most prized of the edible species. It sometimes weighs two thousand pounds.

Fig. 282.



Chelonïa midas, Green Turtle. $\frac{1}{5}$.

* In the Antilles and other breeding-places the turtle is exceedingly valuable. Its eggs are a delicacy; its flesh is used for food; its fat for oil and butter; its carapace for drinking troughs, bathing tubs, canoes, roofs to the native huts, and the tortoise-shell is an article of commerce.

Fig. 283.*Turtle's nest in the sand.*

ORDER LORICATA.

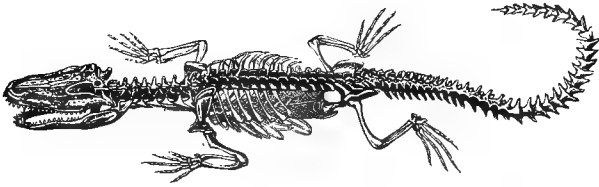
General Characteristics.—The Mail-clad reptiles are found in the swamps and rivers of warm regions. Bony plates set in the leathery hide form a bullet-proof cuirass. The lower jaw is composed of six bones of varying length, put together like the steel plates in carriage-springs. This secures the elasticity required by its inconceivably-quick

Fig. 284.*Alligator's lower jaw.*

snapping bite. To get an enormously-large gape, the lower jaw is articulated to the back part of the skull, giving the appearance of motion to the upper jaw independent of the cranium. The conical, deciduous teeth are constantly renewed. The nostrils at the end of the snout communicate with the pharynx behind cartilaginous plates, which prevent the water from running down the throat, and enable the animal to breathe while it has its mouth open in drowning its prey. The nose and ears are also provided with valves to keep out the water. The tail articulates with the backbone by a ball-and-socket joint, so that with a quick lateral mo-

tion it can knock its victim forward into the mouth which is turned sideways to receive it. The eggs are laid in an artificial heap of mud and vegetable matter, which in decaying

Fig. 285.



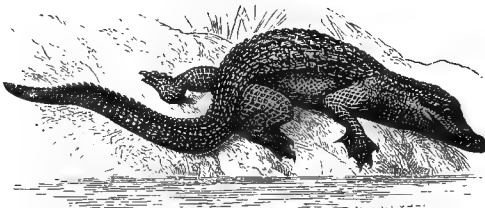
Skeleton of Alligator.

affords heat to hatch them. The mother remains near, and, attracted by the yelping, tears open the pile, liberates the brood of fifty or sixty, and leads them to the water.*

LORICATA. {	MUZZLE NOTCHED TO RECEIVE THE FOURTH TOOTH OF THE LOWER JAW ; FEET WEBBED TO THE NAILS.	}	Crocodilidæ, <i>Crocodile</i>
	MUZZLE WITH A HOLE TO RECEIVE THE FOURTH TOOTH OF THE LOWER JAW ; FEET PARTIALLY WEBBED.	}	Alligatoridæ, <i>Alligator, etc.</i>

Crocodilidæ.—The *Crocodile* of the Nile and the Ganges is thirty feet long, while that of the Western Continent seldom exceeds fifteen. It often ventures out several miles at sea.

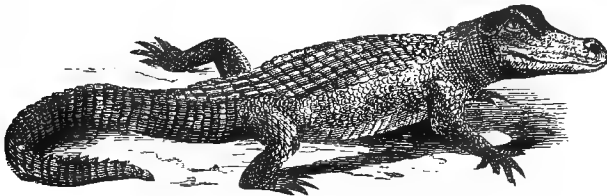
Fig. 286.

*Crocodilus vulgaris*, Crocodile.

* They are so generally the prey of birds, tortoises, and male alligators, that the race would become extinct were not the progeny so abundant.

Alligatoridæ.—The *Alligator* belongs to the New World.

Fig. 287.



Alligātor mississippiensis, Alligator. $\frac{3}{4}$.

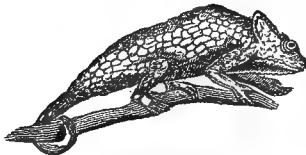
In the colder portions of its habitat it hibernates in the mud, but within the tropics is active at all seasons.

ORDER LACERTILIA.

General Characteristics.—The teeth are simply attached to the surface of the jaw. In the *Leptoglossa* (slender-tongued) group, the tongue is long, nicked, and enclosed in a sheath, from which it can be protruded through a notch when the jaws are closed. In the *Pachyglossa* (thick-tongued), this organ is fleshy, and can be thrust out only when the mouth is open.

Chamæleonidæ.—The *Chameleon* is confined to the Old

Fig. 288.

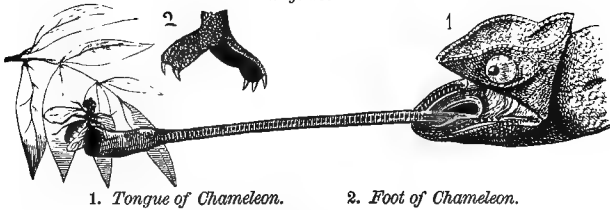


Chamælëon vulgāris, Chameleon.

World.* It leads a double life. It may be asleep on one side and awake on the other. One eye can watch an insect crawling in the rear, and the other in front. When agitated, each half of its body wishing

* Many of the stories current about the chameleon's change of color are doubtless fabulous; yet it can become at pleasure yellow, green, or black. "In the skin," says Bert, "there is a network of minute ducts, connecting with pigment-vesicles on the under surface, which contain the coloring liquid. The tint of the animal depends on the amount of this liquid injected into the ducts." The process seems somewhat analogous to that of blushing in the human species.

Fig. 289.

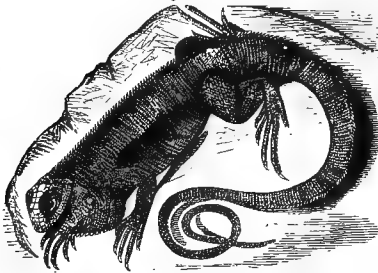


1. Tongue of Chameleon.

2. Foot of Chameleon.

to go its own way, the animal tumbles about as if intoxicated.

Fig. 290.

*Iguana tuberculata*, Iguana. ♂.

Three of its five toes on each foot are united in an opposable bundle to the other two, giving a firm grasp to the branch around which it winds its prehensile tail. It never moves two feet at once, and often carries one sluggishly forward after the other,

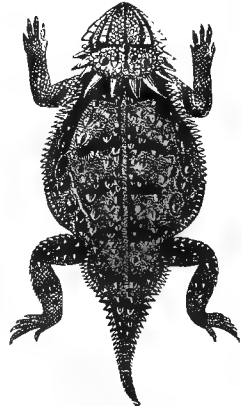
with the imperceptible movement of the hour-hand of a watch; but its long, gummy tongue is quick enough to catch a fly buzzing past, at the distance of twice the length of the Chameleon's body.

Iguanidæ.—The *Iguana* occurs in both hemispheres, but the typical genus only in South America. Some species of this arboreal lizard are prized as food.

Agamidæ.—The *Horned Toad* of Western North America may be tamed as a pet and taught to come and go at call.

Geckotidæ.—The *Gecko* has expanded toes, from which a sticky fluid exudes, enabling it to ascend smooth

Fig. 291.

*Phrynosoma cornuta*, Horned Toad. ♂.

walls and run along ceilings, with its back downward.

Ameividæ.—The Lizards of the New World are small, and useful as destroyers of noxious insects.

Scincidæ.—The *Glass Snake* of the Mississippi Valley is one of the aberrant forms belonging to this

Fig. 292.

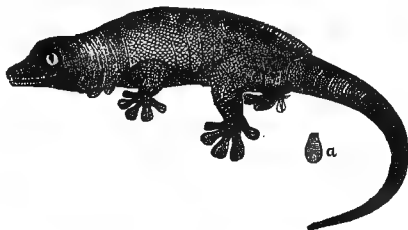
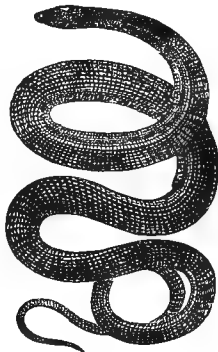
*Platydictyhus seychellensis*, Gecko. $\frac{1}{2}$.

Fig. 293.

*Ameiva sexlineata*, Striped Lizard. $\frac{1}{2}$.

Fig. 294.

*Ophisaurus ventralis*, Glass Snake.

family. When frightened, it contracts its muscles so violently that its tail will break off as if it were brittle.

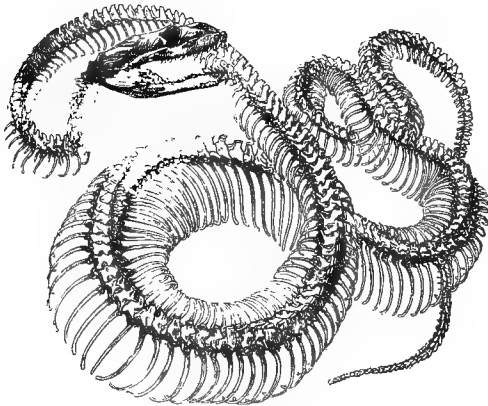
ORDER OPHIDIA.

General Characteristics.—Serpents are distinguished by their dilatable mouth and the absence of a sternum. They crawl by using the movable ribs and under scales as legs.* The vertebræ are joined to each other and to the ribs

* The method is easily realized by allowing one of the non-venomous kind to crawl over the palm or back of the hand.

by ball-and-socket joints. The eyes are destitute of lids, and hence the unblinking stare of a serpent. Some species are hatched from the egg before it is deposited, and are said to be ovoviviparous; but nearly all lay eggs in the sand, to be hatched by solar heat. In some varieties, the mother looks after her young for a season, and swallows them in case of danger. The teeth point backward. Most of the venomous serpents have, in place of teeth in the upper jaw, two fangs, through which the poison is ejected to the bottom of the wound.* The jaws are fastened with elastic ligaments,

Fig. 295.



Skeleton of a Serpent.

which allow them to be separated, so that the snake can swallow an animal twice its own size. Snakes shed their epidermis once, and, in many cases, three or four times a year. It parts around the mouth, and the reptile slides out of it by crawling through a crevice to hold it, reversing the cuticle. The slough is perfect, even to the epidermis of the

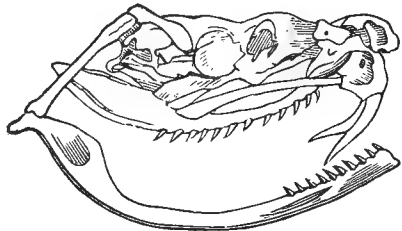
* Snakes, in repose, coil with the tail in the middle and the head outside, laid over, at times, across the folds of the body to the centre of the coil; so that on an alarm they can uncoil with a forward motion, as they have no power of moving tail first. When about to strike, resting upon the latter third of their body, they double themselves into folds, not coils, and suddenly straightening, reach forward their length only, and always instantly recover their darting position.

eyes. In cold climates, snakes hibernate, gathering often in their holes in large masses.*

Crotalidæ.—*Rattlesnakes* have on the end of the tail a series of horny enlargements, loosely attached to each other, which, when shaken, make a rattling noise. Each slough leaves a new button,

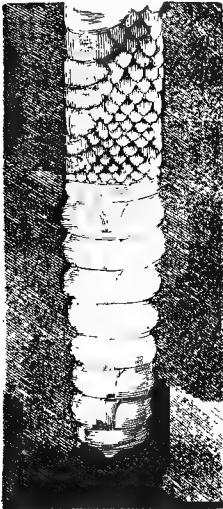
while the end ones are dropping off from wear; hence the number is no indication of age. The Copper-head, Moccasin, etc., are venomous snakes belonging to this family.

Fig. 296.



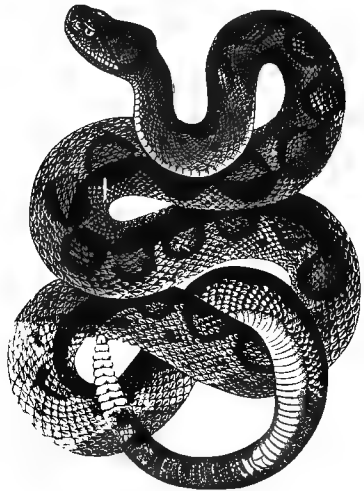
Skull of Rattlesnake, showing fangs.

Fig. 297.



Rattlesnake's tail.

Fig. 298.

*Crotalus durissus*, Rattlesnake.

* Naturalists are divided as to whether snakes have the power of "charming" birds and animals. The general belief is that it is only a paralysis caused by fear on the part of its victim.



Fig. 299.

Bascantion constrictor, Black-snake.

They are more dangerous than the rattlesnake, as they give no warning.*

The *Adder*, a spotted snake of New England, though biting severely, is not poisonous.

The so-called *Vipers* are confined to the Old World. The *Cobra de capello* (*Naja tripudians*) of Southern Asia can expand the upper part of its body

* The percentage of persons dying from the effect of a snake-bite is very small. In many instances fear is more fatal than the poison. Hence the snake that has bitten should be immediately killed, and its mouth examined for fangs. If they are not found, all anxiety may cease at once, with regard to all our land snakes. If discovered, the only known remedy is some form of alcoholic drink, which should be taken as speedily as possible in large quantities, till intoxication results, which is a sign that the poison is neutralized.

into a kind of hood, and its dilation is a sign of anger, as strikingly as the rattle in *Crotalus*. The hood is marked by a figure not unlike a pair of spectacles. The bite is greatly dreaded, as the poison is very subtle. In India, the Cobra is revered, and when one takes up its abode in a house, the Hindoo will induce it to enter an earthen jar, and then carefully carry it off to a distance and release it.*

Colubridæ.—The Black-snake, Striped-snake, Water-snake, etc., are included in this family. They are all perfectly inoffensive.

Fig. 300.

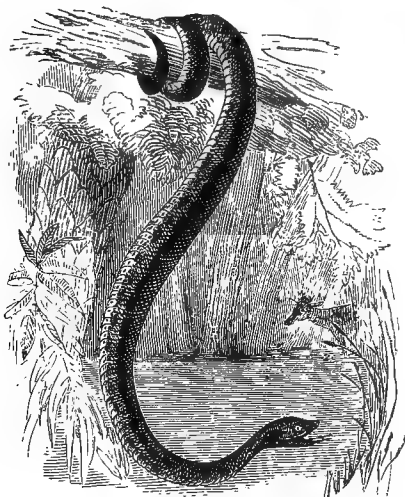
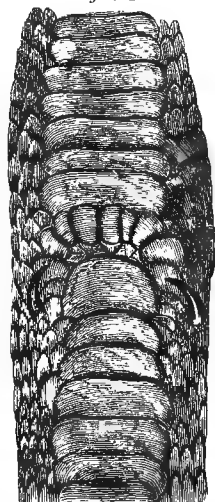
*Boa anaconda.*

Fig. 301.

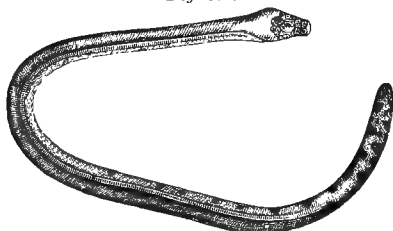
*Hooks of Anaconda.*

Boidæ.—The Boa and Anaconda of South America, and the Python of Africa and the East Indies, are the largest ser-

* This serpent is also used by snake-charmers, who handle it with impunity and pretend to throw it into a lethargy and bring it out at will. "Drawing the reptile from its cage they will irritate it by presenting a stick. The animal immediately erects the fore part of its body, swells its neck, opens its jaws, extends its forked tongue, and begins to hiss. Then a sort of battle begins between the serpent and the charmer. The latter striking up a monotonous song, opposes his clenched fist to his enemy; the former fixes its glittering eyes upon the fist and follows all its movements, balancing its head and thus keeping up a kind of dance."

pents known. They are frequently found over twenty feet in length. Their bite is harmless, but, suspending themselves from the branches of trees, they dart upon their victims as they pass beneath, entwine them in massive folds, crush their bones, and then swallow them entire.*

Fig. 302.



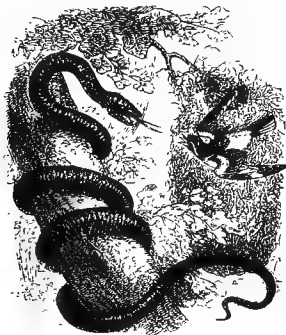
Sea-snake.

Hydrophidæ.—The *Sea-snakes* inhabit the fresh and salt waters of warm regions. They are distinguished by their vertically-flattened tail and uniform arrangement of teeth, showing no distinct fangs, though proved to be highly venomous. The nostrils, on

the upper part of the snout, are provided with valves, which proves them to be air-breathing. At least forty-eight species have been discovered, all but six belonging to the Eastern Hemisphere.

* To aid in grasping the limb, they have on each side, at the base of the tail, a horny spur. These are internally connected with a series of bones, rudimentally representing the hind legs of quadrupeds.

Fig. 303.

*Bascanion constrictor*, Black-snake.

CLASS IV. AMPHIBIA.

General Characteristics.—Amphibians have a double life—an immature or tadpole stage passed in the water, during which they breathe by gills; and a mature stage passed in the air, during which they breathe by lungs. To this metamorphosis there are a few exceptions, but the typical species lose the gills and tails by absorption, and develop lungs and limbs. Some retain the tails and others the gills, but all when mature have lungs. As a rule, the tadpoles are herbivorous, the adults carnivorous.

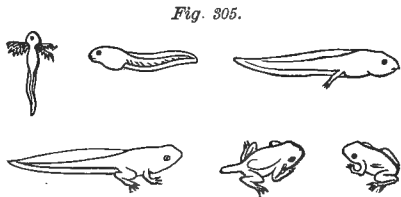
AMPHIBIA.	{	TAILS AND GILLS TRANSIENT.	Anura,	<i>Frog, Toad, etc.</i>
		TAILS PERMANENT AND GILLS TRANSIENT.	Urodela,	<i>Salamander, etc.</i>
		TAILS AND GILLS PERMANENT.	Amphipneusta,	<i>Siren, etc.</i>

ORDER ANURA.

General Characteristics.—The Tailless Amphibians are distinguished by their broad heads, naked skin, prominent but retractile eyes, and, in the adult state, lack of tails. The eggs are laid and hatched in the water. The young tadpole resembles a little fish, with a large head and compressed tail, but no limbs. Soon gills (branchiæ) appear; and then small, vascular tufts aid respiration by extracting air from the water that passes through the mouth and out of temporary slits.



Skeleton of a Frog.



Tadpole changes.

At length the posterior extremities show themselves; then the anterior; the tail is absorbed (not dropped off); the lungs are developed; the branchiæ waste away; and the little animal matures into a frog. Destitute of ribs, it breathes like the tortoise, by swallowing air.

ANURA. Tongue	{	PRESENT; TYMPANUM DISTINCT; UPPER JAW TOOTHED.	}	Ranidæ,	<i>Rana pipiens,</i>	<i>Bull-frog.</i>
		PRESENT; TYMPANUM INDISTINCT; JAWS TOOTHLESS.		Bufo	<i>Bufo americana,</i>	<i>Common Toad.</i>
		ABSENT; TYMPANUM CONCEALED; JAWS TOOTHLESS.		Pipidæ,	<i>Pipa americana,</i>	<i>Surinam Toad.</i>

Ranidæ.—The *Common Frog* (*Rana pipiens*) is a type of this family. Living mostly in the water, the toes of

Fig. 306.

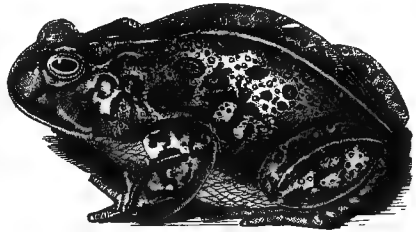


Rana pipiens, Bull-frog.

its hind limbs are webbed. The *Tree Frog* (*Hylidæ*) has a viscid ball or sucker on each of the toes, by which it can climb easily. It lays its eggs on trees which overhang the water, and, when hatched, the young drop into it. In cold latitudes, all the species hibernate in the mud.

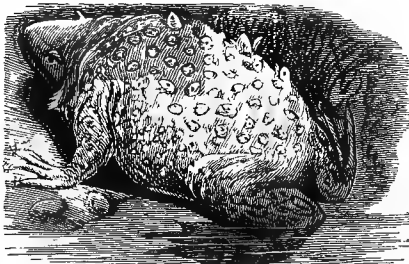
Buфонidae.—Toads differ from frogs in the absence of teeth on the upper jaw. They hibernate beneath rocks and in holes which they dig in the ground,* only visiting the water to lay their eggs. Living exclusively upon insects, and having a voracious appetite, † no more useful animal can be harbored in a garden. In both frogs and toads, the tongue is fastened

Fig. 307.

*Bufo americanus*, Common Toad.

at the front of the mouth instead of the back. The viscid tip, armed with two finger-like prongs, can be darted out with incredible velocity. An insect venturing near is thus glued fast and put down the animal's throat without mastication.

Fig. 308.

*Pipa americana*, Surinam Toad. ‡.

Pipidae.—The *Surinam Toad* lays its eggs in the water, but the male quickly places them upon the back of the female. Adhering to this, cells soon form beneath, in which they

become imbedded. Here the young are hatched, and pass

* No doubt they can remain a long time without food, but there is no well authenticated instance of their having been found enclosed in cavities of solid rock with no crevices connecting with the outside world.

† A naturalist once fed to a toad twenty-three squash-bugs and ninety-four caterpillars, an inch and a half in length, before it turned away to digest its meal. Feeding mostly by night, the toad is of great aid to the Entomologist in furnishing him with specimens of insects he might otherwise never see; though he is compelled to sacrifice the life of his assistant in order to avail himself of its services. In spite of popular prejudice against handling toads, etc., all the members of this order are perfectly harmless, except a temporary smarting that the exudations of the skin may produce if transferred from the hands to the eyes.

through the usual metamorphosis from the tadpole to the full-limbed stage. Finally, the whole brood emerge, presenting a singular sight as they struggle out with heads and paws projecting in all directions.

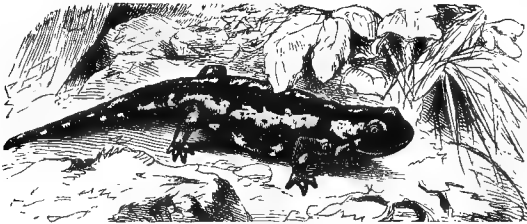
ORDER URODELA.

General Characteristics.—The Tailed Amphibians resemble lizards, but, unlike them, have gills in the early stage of their development. Except the retention of their tails, they pass through essentially the same transformations as the Anura, the fore limbs, however, appearing before the back ones.

URODELA; Salamandridæ.	{	TAIL CYLINDRICAL; TERRESTRIAL; VIVIPAROUS.	{	<i>Salamandra maculosa,</i>	<i>Salamander.</i>
		TAIL FLATTENED; AQUATIC; OVIPAROUS.		<i>Triton cristatus,</i>	<i>Newt.</i>

Salamandridæ.—The *Salamander* exudes a milky, glutinous kind of perspiration. By its evaporation this will for a time protect the body from the heat, and hence the popular

Fig. 309.



Salamandra maculosa, Salamander. $\frac{1}{2}$.

superstition that the animal is fire-proof. The *Newt* skillfully encloses its eggs, deposited singly, in the fold of a leaf whose edges are carefully glued together. It possesses a remarkable facility for repairing damages; if a tail or leg be broken off, it will be restored, and the operation may be repeated many times.*

* The branchiæ of the Frog and Newt, when the limbs are partially developed,

Fig. 310.

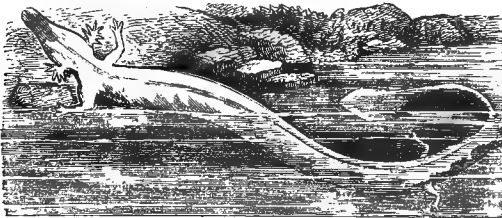
*Triton cristatus*, Newt or Triton.

Fig. 311.

*Sierradon lichenoides*, Axolotl. $\frac{1}{2}$.

Amphipneusta.—The Double-breathing Amphibians present anomalous forms, which are of interest on account of the apparent permanency of their gills. Among them are the Siren, or Mud-eel, of the Carolina rice swamps, the Axo-

Fig. 312.

*Protēus anguinus*.

lotl of the Mexican lakes, and the Proteus, which inhabits certain caves in Austria, and has only rudimentary eyes. Recent investigations suggest a doubt whether they are not merely the larvæ of other animals whose life history is not yet fully known.*

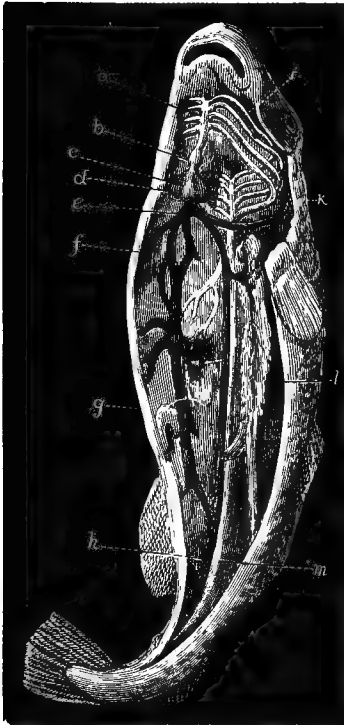
furnish the most convenient means for observing the circulation of the blood. Placing the little creature in a vial, with a pocket-lens the globules may be seen chasing one another as they go out through the arteries and return by the veins.

* As they have tuft-like branchiæ besides lungs, they have been thought to illustrate the general law that the "transient embryonic stages of the higher members of any division of the animal kingdom are often represented by the permanent condition of its lower members."

CLASS V. PISCES.

General Characteristics.—Fishes rank lowest among vertebrates. Their bodies occupy a horizontal position, with

Fig. 313.



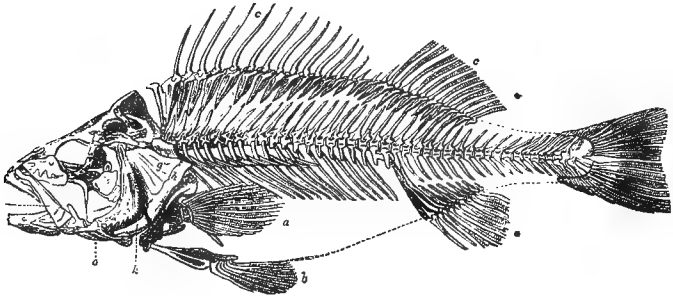
CIRCULATORY SYSTEM OF FISH.—a. Branchial artery; b. Arterial bulb; c. Ventricle of heart; d. Auricle; e. Venous sinus; f. Vena portæ, etc.; g. Intestine; h. Vena cava; i. Gill vessels; k. Dorsal artery; l. Kidneys; m. Aorta.

no power even of elevating the head independently. Their senses are blunted. Their eyes are large, but generally have no motion. The external ears are wanting. They progress mainly by horizontal movements of the vertical tail, in marked contrast with the vertical movements of the horizontal tail of the mammals inhabiting the water. The two pairs of fins underneath, corresponding to the four limbs of quadrupeds, as well as the fins upon the back, serve as balancers. Most fishes have a swimming-bladder—a sort of rudimentary lung—whose use is doubtful, though it is thought to be serviceable in changing their specific gravity. They breathe by means of gills. These are delicate fringes or laminæ on each side of the head, generally protected by a bony lid called the *gill-cover*. The water, usually taken into the mouth in a

way similar to the act of swallowing, bathes the gills, and is then

discharged at the *gill-openings*. Meanwhile, the blood circulating in the gills absorbs the oxygen of the air which the water contains, and is purified. As the heart has but one

Fig. 314.



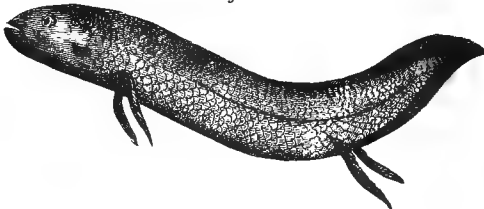
SKELETON OF A FISH.—a. Pectoral Fins ; b. Ventral ; c. Dorsal ; d. Anal ; Tail, caudal.

auricle and one ventricle, the blood, after being aerated in the gills, is not returned to the heart, but is driven directly through the body. The mouth is the only prehensile organ. All the species are essentially oviparous, a few being ovoviparous.

ORDER DIPNŌI.

General Characteristics.—The Double-breathing fishes have both gills and lungs, two pairs of limbs, and two auri-

Fig. 315.



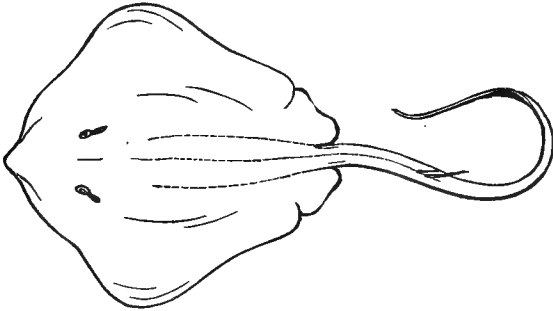
Lepidosiren annectens, Mud-fish. $\frac{1}{16}$.

cles. They thus ease the transition from the Amphibians to the Fishes. There is only one family, the singular *Mud-fish* of tropical rivers.

ORDER ELASMOBRANCHII.

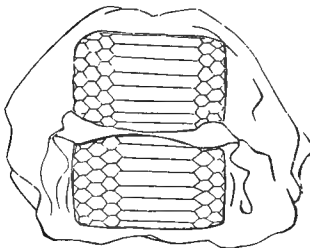
General Characteristics.—The Strap-gilled fishes have fixed gills and no gill-covers. Their skeleton is cartilaginous; skin, rough; and the ventral fins are far back. In some families the tail-lobes are of unequal length (*heterocercal*).

Fig. 316.

*Pastinaca hastata*, Sting Ray.

Raiidæ.—The *Rays* are noted for their enormous pectoral fins, formidable tail, and tessellated teeth. They sometimes weigh half a ton. The teeth are adapted to crushing sea-weed and shell-fish; while the tail, armed with hooked spines, can be suddenly lashed around an enemy, the barbs frightfully lacerating the flesh.*

Fig. 317.



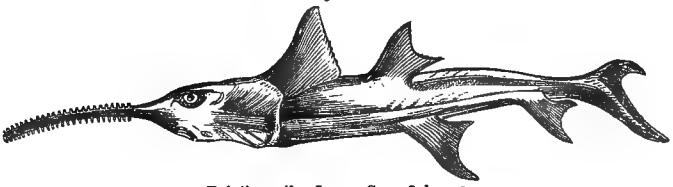
Tessellated Teeth of a Ray.

Rhinobatidæ (nosed-skate).

—The *Saw-fish* has a sword-like snout one-third the length of the body, and edged with tooth-like spines. Brandishing this among a school of fishes, many are at once disabled, and afterward eaten at leisure.

* To this family belongs the famous *Torpedo*, which on being touched gives a violent electric shock. It possesses a kind of voltaic pile composed of parallel prisms, 1262 of which have been counted in a single fish. The electricity has been used in galvanic experiments, as making a magnetic needle, etc.

Fig. 318.

*Pristis antiquorum*, Saw-fish. $\frac{1}{50}$.

Zygænidæ (yoked).—The Sharks are the butchers and scavengers of the ocean. They follow ships pertinaciously, swallowing greedily anything thrown overboard.* Their teeth

Fig. 319.

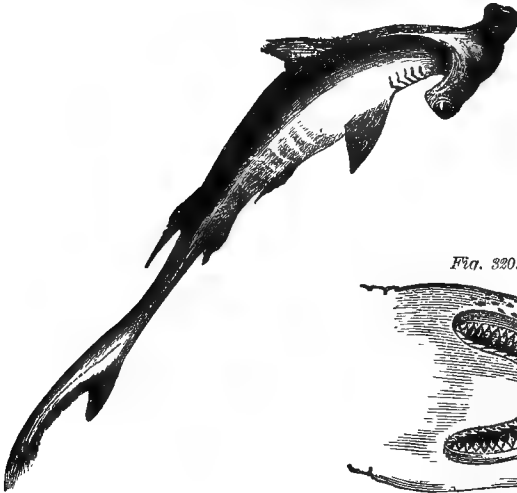
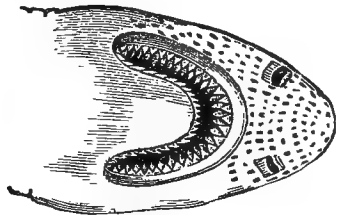
*Zygæna malleus*, Hammer-head Shark. $\frac{1}{50}$.

Fig. 320.



Shark's Teeth.

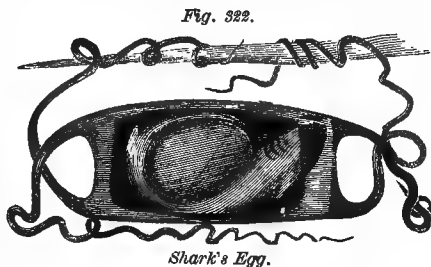
* On slow-sailing merchant-ships, shark-fishing is a favorite pastime, especially when the vessel is becalmed. A recent account says: "I was holding the heavy hook and wire rope over the side, when I felt that I had caught a big fish, and pulling it cautiously, a shark came to the surface. I called out, when the passengers ran to my help. He struggled so violently, lashing the water with his tail and trying to bite the hook asunder, that we were obliged to keep dipping his head under water and then haul him up two or three feet to let it run down his throat. At last he was nearly drowned, when, sending a running bow-line down the rope by which he was caught, and making it taut under his back fin, we clapped the line around the steam

Fig. 321.



1. *Acipenser oxyrinchus*, Sturgeon. 2. *Silurus glanis*, Sly Silurus.

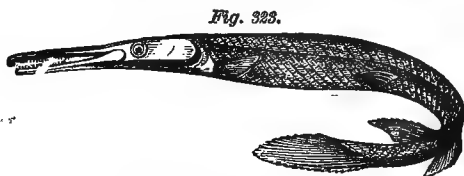
are in numerous rows, held by strong skin upon the rounded edge of the jaws; but only the outer row stands perpendicularly and can be used. As fast as any drop out from wear or fracture, inner ones move forward to take their place. The *Hammer-head Shark*



is sometimes thirty feet long. Its eyes are at the end of the lateral prolongations of the head, which can be bent so that the shark can see its victim on both sides as it settles down upon it. The eggs of both Rays and Sharks are horn-like sacs, with tendrils for clinging to the sea-weed.

ORDER GANOIDEI.

Ganoidei (enameled).—The Ganoids include the *Gar-pike*, with its enameled scales in oblique transverse rows,



Lepidosteus ossæus, Gar-pike. $\frac{1}{2}$.

and the *Sturgeon*, with its bony plates. The latter feeds upon the garbage and vegetation on the muddy bottoms of the great rivers.

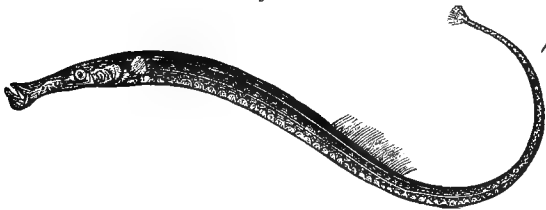
winch, and turned the steam on. Some then hauled his tail up, while all available hands dragged at the other line, which held his head. As soon as we got him on board he broke off about three feet of the ship's bulwarks by a single lash of his tremendous tail. This was then cut off by the boatswain with a hatchet, while a dozen of us with bowie-knives finished him. We found in his stomach six large snakes, two empty quart bottles, two dozen lobsters, a sheep-skin and horns and the shank-bones, which the cook had thrown overboard two days before. The liver filled two large wash-deck tubs, and when tried out gave us ten gallons of oil."

ORDER TELEOSTEI.

General Characteristics.—The Teleosts (perfect bone) include nearly all the common fishes. The skeleton is more or less ossified, the skull complicated, the single gill-opening protected by a bony flap or “gill-cover” (*operculum*), and the tail equal-lobed (*homocercal*).

Syngnathidæ (jaw-tied).—The *Pipe-fish* has a tube-like jaw. Its single dorsal fin, set far back, works like the screw

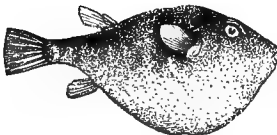
Fig. 324.

*Syngnathus peckiānus*, Pipe-fish. $\frac{1}{2}$.

of a propeller. The male has a kind of marsupial pouch, in which the female places the egg for hatching, and thither the young flee for safety. It feeds upon minute insects and shell-fish, thrusting its long snout into every crevice, and sometimes, where that cannot enter, blowing in water to drive out its prey.

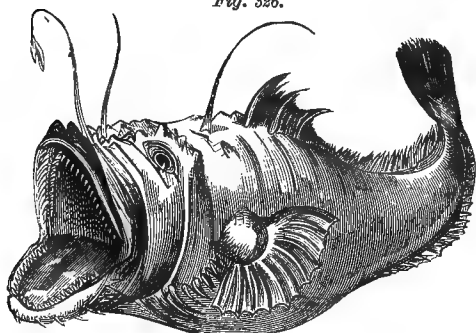
Diodontidæ (two-toothed).—The *Puffer* inflates its body by swallowing air. Floating bottom up, it presents to its enemies beneath only a ball of spines, with which its back is thickly covered.

Fig. 325.

*Tetraodon turgidus*, Puffer. $\frac{1}{2}$.

Lophiidæ (crested).—The *Fishing Frog* has the ventral fins forward of the pectoral. The latter serve as legs, and enable it to hop about upon the beach. Upon the head are three spines—the first, with a shiny membrane at the tip, fastened by a ring-and-staple joint and able

Fig. 326.

*Lophius americanus*, Fishing Frog. $\frac{1}{2}$.

to move in every direction ; the other two turning only backward and forward. The sluggish creature lies in the mud at the bottom of the water, and, waving the first spine, attracts the curious fishes with this glistening bait ; but, as they nibble, the rear spines knock them into its capacious mouth.

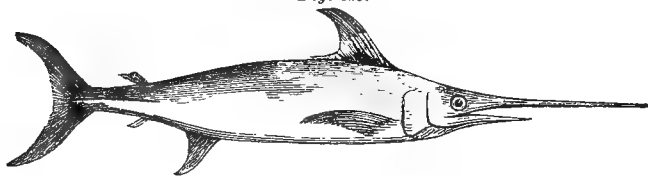
Percidæ (dusky).—*Perch* are found both in salt and fresh water. Their operculum is so constructed that they can be kept alive in the air for hours by occasionally pouring water upon their gills.

Fig. 327.

*Perca flavescens*,
Yellow Perch. $\frac{1}{2}$.

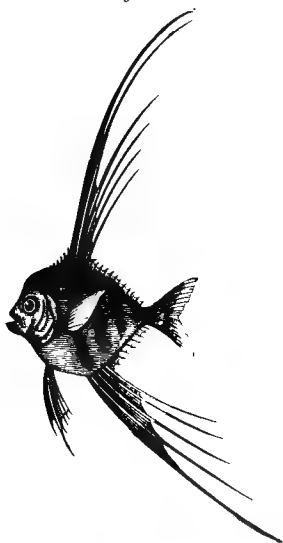
Xiphiidæ (sword-like).—The *Sword-fish* is remarkable for its upper jaw being prolonged into a formidable weapon. As its food consists only of squid and small fishes, the use of the "sword" is a mystery.*

Fig. 328.

*Xiphias gladius*, Sword-fish. $\frac{1}{2}$.

* Some species have a sword so strong that it has frequently been driven through the coppered hull of a vessel, a third of its length being sawed off on the inside.

Fig. 329.

*Blepharis crinitus*, Cobbler-fish. $\frac{1}{2}$.

Scomberidæ (mackerel-like).
—The *Mackerel*, in May and June, approach the shores in enormous shoals to spawn, and great numbers are then caught for market.

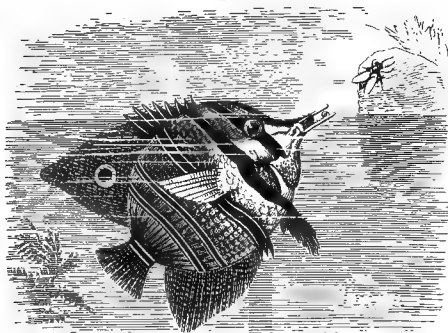
Fig. 330.

*Scomber vernalis*, Mackerel. $\frac{1}{2}$.

Blepharidæ.—The *Cobbler-fish* is noticeable for the lengthening of the spines of the dorsal and anal fins into hair-like filaments.

Chætodontidæ (hair-toothed).
—The *Archer* can shoot a drop of water from its mouth with such precision as to bring down a fly at the distance of two or three feet.

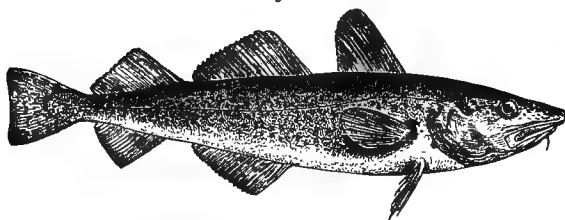
Fig. 331.

*Chætodon rostratus*, Archer. $\frac{1}{2}$.

Gadidæ.—The *Cod** is caught in deep seas with hook

* The use of the barbule on its chin is unknown, unless from its similarity to a worm it may be attractive to the smaller fish upon which the Cod preys.

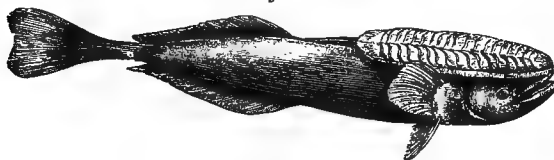
Fig. 332.

*Morrhua americana*, Cod. $\frac{1}{2}$.

and line. It is so numerous in certain localities that eight men have taken eighty score in a single day. Nine millions of eggs have been found in the roe of one female.

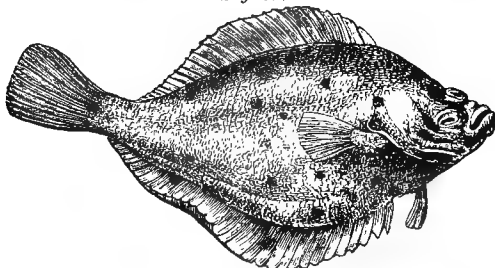
Echeneidæ (ship-holder).—The *Remora*, or Sucker-fish,

Fig. 333.

*Echeneis albicauda*, Remora. $\frac{1}{2}$.

has on its head a flat disc, not unlike the sole of an India-rubber shoe. This enables it to cling to rocks, vessels, and even to other fish, twelve or fifteen having been found hanging to a single shark. The pressure of the atmosphere holds

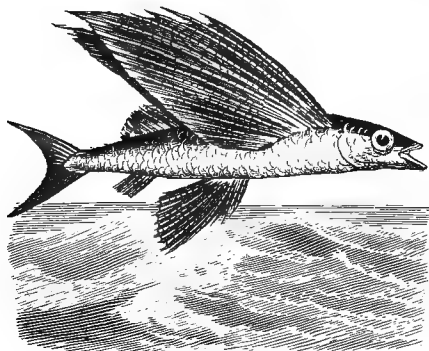
Fig. 334.

*Platessa plana*, Flat-fish. $\frac{1}{2}$.

it so tightly that a strong man can hardly drag it loose. This arrangement probably serves it for cheap and easy transportation, as it is not a good swimmer.

Pleuronectidæ (side-swimmer).—The *Flat-fish* has its head singularly twisted, so that both eyes are on the same side of the body. This is always the upper and dark-colored, while the lower side is white. The Family furnishes im-

Fig. 335.



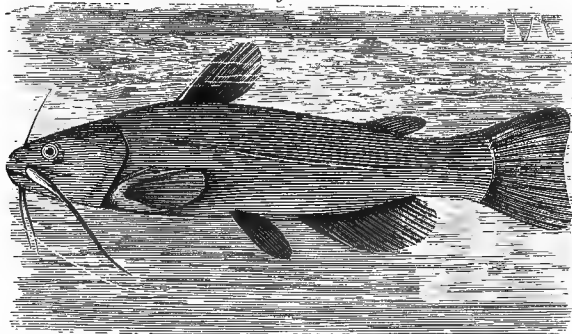
Exocoetus volitans, Flying-fish. ♀.

portant food fish as the Halibut, Turbot, Sole, and Flounder; the first sometimes reaching a weight of six hundred pounds.

Exocœtidæ (sleeper-out).—The *Flying-fish* has large pectoral fins, by which it can support itself in the air for a few seconds.* Its brilliant coloring makes it the common prey of bird and fish.

* This so-called "flight" is only the result of an impetus acquired by swimming to the surface with great velocity, in order to escape its enemies. It cannot change its course nor raise itself in the air, and its fins cannot be flapped like wings, but serve only as a parachute.—Capt. Basil Hall gives a very animated description of the pursuit of a school of flying-fish by a dolphin (*Coryphæna hippæris*, Coryphene, note, p. 84). "The flying-fish took their flight to windward. A large dolphin, which had been keeping company with us abreast of the weather gangway, and, as usual, glistening most beautifully in the sun, no sooner detected our poor dear friends take wing than he turned his head toward them, darted to the surface, and leaped from the water with a velocity little short, as it seemed to us, of a cannon-ball. But though the impetus with which he shot himself into the air gave him an initial velocity greatly exceeding that of the flying-fish, the start which his fated prey had got enabled them to keep ahead of him for a considerable time. The length of the dolphin's first spring could not have been less than ten yards, and after he fell we could see him gliding like lightning through the water for a moment, when he again rose and shot upwards with considerably greater velocity than at first, and of course to a still greater distance. In this manner the merciless pursuer seemed to stride along the sea, while his brilliant coat sparkled and flashed in the sun. As he fell headlong in the water at the end of each leap, a series of circles was sent far over the surface, for the breeze—just enough to keep the royals and topgallant studding-sails extended—was hardly felt as yet below. The group of wretched flying-fish,

Fig. 336.

*Pimelodus atrarius*, Cat-fish or Horned-pout. $\frac{1}{2}$.

Siluridæ.—The *Cat-fish*, or Horned-pout, has a naked skin, and the mouth surrounded by tentacles.

Clupeidæ (shād-like).—The *Herring* ascends fresh-water streams to spawn, thus coming each spring from the depths of the ocean to the hand of man. Immense schools go up the same stream in which they were spawned the previous year, and always select the branches leading to certain head-waters, for which they have a preference.

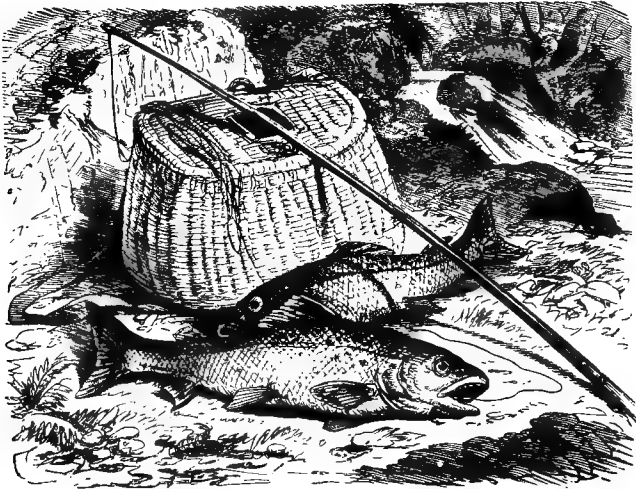
Fig. 337.

*Clupea serrata*, Herring. $\frac{1}{16}$.

thus hotly pursued, at length dropped into the sea ; but we were rejoiced to observe that they merely touched the top of the swell, and instantly set off again in a fresh and even more vigorous flight. The direction they now took was quite different from the one in which they had set out, implying that they had detected their fierce enemy, who was gaining rapidly upon them. The greedy dolphin was fully as quick-sighted; for whenever they varied their flight in the smallest degree, he lost not the tenth part of a second in shaping his course so as to cut off the chase ; while they, in a manner really not unlike that of the hare, doubled more than once upon their pursuer. But it was soon plainly to be seen that the strength and confidence of the flying-fish were fast ebbing; their flights became shorter and shorter, and their course more fluttering and uncertain, while the leaps of the dolphin seemed to grow more vigorous at each bound. Eventually this skilful sea-sportsman seemed to arrange his springs so as to fall just under the very spot on which the exhausted flying-fish were about to drop. This catastrophe took place at too great a distance for us to see from the deck what happened; but on our mounting high on the rigging, we may be said to have been in at the death ; for then we could discover that the unfortunate little creatures, one after another, either popped right into the dolphin's jaws as they lighted on the water, or were snapped up instantly after."

Salmonidæ.—The *Salmon* has habits similar to those of the Herring, but, on account of its greater size, is able to ascend waterfalls ten or twelve feet in height. Arrived at the spawning ground, a hole is scooped in the gravel and the eggs deposited and covered over, the parent returning leisurely to the sea. Its food in the ocean consists of small shell-fish, not excepting its own progeny.

Fig. 338.

*Salmo salar*, Salmon. $\frac{1}{8}$.

The **Esocidæ** include the voracious European *Pike* and American *Pickrel* (*Esox reticulatus*). They are masters of the waters in which they reside, destroying mercilessly every other fish and even the young of their own kind, as well as mammals and birds—three water-rats and the remains of a duck having been found in the stomach of one pike.* Hence they should be exterminated from all streams intended for the raising of trout, gold-fish, and other soft-finned fishes.

* A swan was perceived to keep its head under water longer than usual. Upon examination it was found that a pike had so far gorged its head as to kill both itself and the swan.

Fig. 339.

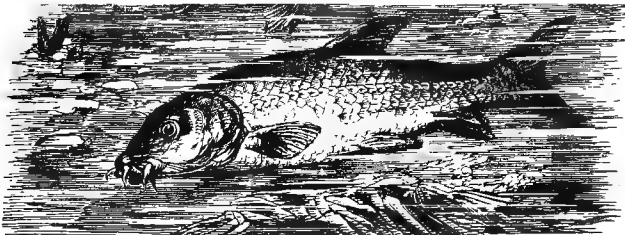


1. *Cyprinus carpio*, European Carp. 2. *Esox lucius*, European Pike.

Cyprinidæ.—The *Carp*, indigenous to Europe, has been successfully naturalized in America. It is especially cultivated in reservoirs for the table, attaining sometimes to the weight of 100 pounds, and living to the age of 150 years.

The *Gold-fish* (*Cyprinus auratus*), originally from China, has become a common pet of the parlor and the fountain.*

Fig. 340.



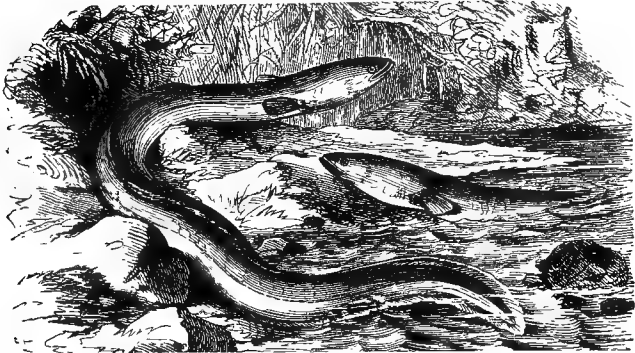
Cyprinus barbatus, Barbel, Europe.

* Gold-fish should be fed once a week with some animal food, as worms, and more frequently with stiff dough of flour and water.

The Silver-fish is only a variety of the Gold, resulting from artificial treatment.

The *Barbel*, belonging to the same genus, has four beards or barbules hanging from the mouth, probably to aid it in grubbing with its nose in the soft banks for aquatic larvæ.

Fig. 341.



Anguilla latirostris, Broad-nosed Eel. $\frac{1}{7}$.

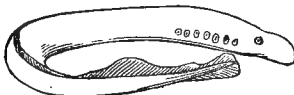
Anguillidæ (snake-like).—The *Common Eel* is oviparous, and so tenacious of life as to wander across dewy meadows from pond to pond, its gill-openings being far back and thus protecting the gills from drying.

ORDER MARSIPOBRANCHII.

General Characteristics.—The Pouch-gilled fishes have a cartilaginous skeleton, naked skin, only one nasal organ, and no lower jaw.

Petromyzonidæ (stone-suckers).—The *Lamprey* occurs in both salt and

Fig. 342.



Petromyzon americanus, Lamprey. $\frac{1}{5}$.

Fig. 343.



Mouth of Lamprey.

fresh water. Its mouth is simply a circular sucking-cup, armed with numerous teeth. The tongue, working like a piston, produces a vacuum by which the animal adheres to any object. Assisted by the current, it thus drags away quite large stones from the spot it chooses for depositing its spawn.

ORDER PHARYNGOBRANCHII.

Pharyngobranchii (gullet-gilled). The *Lancelet*, a singular little fish not over two inches long, found on different coasts, is the only representative of this order. It has no skull, jaws, brain, heart, true fins, nor eyes. The mouth is only a slit. It swims by means of a membranous border above and beneath. Yet the little creature breathes, eats, and its blood circulates by means of rhythmical contractions of the vessels. It is considered the lowest type of organization yet known in the Vertebrata.

Fig. 344.



Branchiostöma lanceolätus, Lancelet.

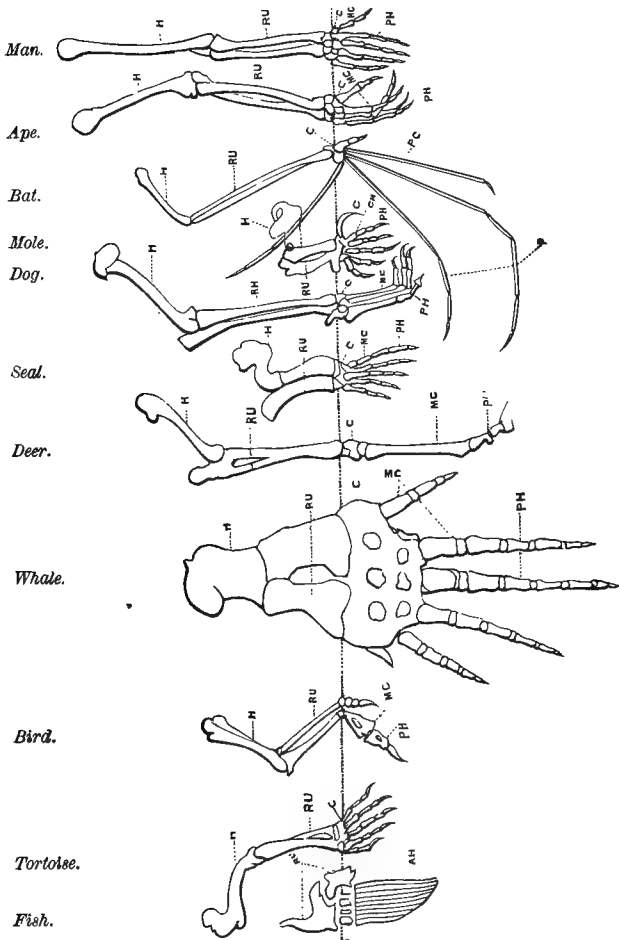
HOMOLOGIES AND ANALOGIES OF THE VERTEBRATES.

A comparison of Figs. 26, 58, 70, and 116, illustrating the anatomy of some of the various orders of Mammals, shows a remarkable similarity of structure. Thus, while the figure and size of the head of the mammals vary greatly, it is always composed of the same parts, marked by the same processes and united in the same order. Any difference is only a modification of form and structure, rather than of omission or addition. These variations are least observable in the embryonic state, and become more apparent in maturity, through the ossifying or non-ossifying of the sutures, the greater or less development of the processes for muscular attachment, and the adaptation of the cranium to the size and shape of the brain. The so-called "facial angle," formed by a line drawn from the forehead to the most prominent part of the upper jaw, and meeting a line from the middle of the ear to the base of the nose, shows the difference in the form of the head, and is an index to the intelligence of the several orders of mammals.

Homologies of Limbs in the same Animal.—In the skeleton of the horse, a careful study of the angle formed by the scapula and humerus with that formed by the ilium and femur, will show how antagonism in direction gives stability of position. Were

both angles directed the same way, the bones would shut together and the animal fall. That there may be a double antagonism and a lower

Fig. 345.



LMBS.—Anterior members of Vertebrata.
 H. Humerus ; RU. Radius and Ulna ; C. Carpus ; MC. Metacarpus ; PH. Phalanges

against an upper, the angle formed by the humerus and forearm antagonizes that formed by the femur and leg ; but each respectively

in the contrary direction to the antagonism immediately above it, thus intensifying the stability.

Homologies of the Limbs of different Animals.—Comparing the anterior limbs of different orders of mammals with those of birds, reptiles and fishes (See Fig. 345) the same fundamental idea will be recognized in all, yet so modified as to adapt the several species to the most diversified modes of life. Thus from man to the fish are found the humerus (H), the radius and ulna of the forearm (RU), the carpal bones (C), the metacarpal (MC), and the phalanges (PH). The greatest modification is observable in the wrist-bones (indicated by the dotted line) and those beyond. The normal number of carpals, metacarpals, and phalanges, is sometimes reduced and sometimes multiplied, that the limb may be used specifically, according to the wants of the animal, for swimming, crawling, flying, paddling, running, digging, climbing, etc. The perfection of the human hand, which combines nearly all these uses, depends chiefly on the free revolving motion of the humerus and the rotation of the radius about the ulna. This mode of action necessitates a clavicle. The more perfect this bone, the greater the power of rotating the forearm; and, when the clavicle is wanting, the radius and ulna are usually consolidated and the fore limbs become only columns of support or instruments of progression. This latter condition existing in the horse and the ruminants, the metacarpals are greatly elongated, elevating the heel to the height of the knee in other quadrupeds, and permitting the toe only to touch the ground.

The posterior extremities follow the analogies of the anterior in most mammals, the true knee with its patella being more or less concealed in the flanks, with a corresponding elongation of the heel, the toe only touching the ground.

Laws of Comparative Anatomy.—The foregoing remarks upon homologies and analogies prepare for a deduction of some of those great laws of coexistence, which lie at the foundation of comparative anatomy.

1. Since the extremities by means of which the animal procures its food must always bear a certain relation to the teeth which masticate and fit it for the stomach, the former decide the animal's external structure, and the latter its internal organization.

2. The position and size of the processes of different bones determine the direction and force of the muscles by which they are worked.

3. The character of the muscles determines the structure of the nerves which call them into action, and of the brain in which the nerves originate.

4. The nervous system determines the degree of intelligence.

The structure of an animal, its natural habit and mode of life, can be deduced from the bones of the extremities, and even from the

ends only of any one of them. For instance, the shape of a single finger-bone indicates the necessary form of the one with which it articulates; this latter its fellow, and so on through the series including the metacarpal, carpal, radius and ulna, humerus, scapula and clavicle. The result of this investigation suggests at once to a comparative anatomist the structure of the teeth, whether herbivorous or carnivorous, and thus enables him to decipher the entire character of the animal. Any bone in the series answers equally well for a starting-point, and the skill of the investigator is shown in the readiness with which he reconstructs the whole bony fabric from the extremity furnished. Thus Cuvier, from single bones found in the gypsum near Paris, drew the entire outline of fossil genera of mammals; and Agassiz, from isolated scales, restored the whole fish. (See Geology, pp. 182 and 203.)

HINTS FOR STUDYING REPTILIA, AMPHIBIA AND PISCES.

In the latitude of southern New England during fifteen or twenty days after June 10th, the smaller tortoises may be found about sundown on the margins of the ponds and streams digging holes and laying their eggs; the larger, as *Chelydra serpentina*, doing the same thing about sunrise in the morning. Removing the eggs carefully without turning them over, they may be placed two or three inches deep in garden sand, protected with net-work, kept moist, and so the progress of embryonic development watched till they hatch in September or October, by examining one egg at a time every two or three weeks.

The Amphibia may be studied in a similar way by transferring frog and toad spawn, found in streams about the first of June, to a glass vessel of water containing sand and pebbles. It will be noticed that frogs' eggs are in a glairy mass; toads' eggs in a glairy string. If a female newt be placed in the vessel with some growing aquatic plant like spotted knot-weed (*Polygōnum persicaria*), its curious habit of folding a leaf in which to deposit its egg may be observed, and in time all the changes pertaining to its metamorphosis.

Large Reptiles, Amphibians and Fishes may be skinned and preserved according to the directions already given for Mammals and Birds. Small specimens should be kept in alcohol, after making an incision low down on the side, by simply inserting a penknife at as small an angle to the surface as will permit the point to enter the cavity of the abdomen. After a few days, alcoholic specimens should be changed into fresh alcohol at least 80° proof. Glycerine may be substituted for alcohol, when it is desirable to preserve the colors.

II. SUBKINGDOM ARTICULATA.

General Characteristics.—The Articulates (jointed) constitute more than four-fifths of the Animal Kingdom.

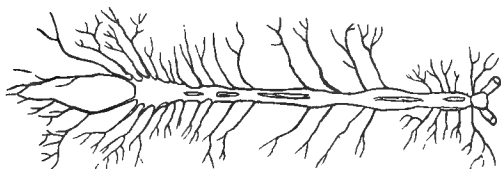
Fig. 346.



An Articulate.

The body is composed of a series of rings, formed of skin more or less hardened and serving for a skeleton (Table, p. 13).

Fig. 347.



Nervous System of Insects.

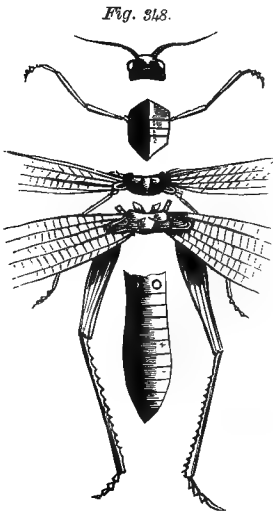
Each segment generally has its nervous ganglion, which acts independently as a kind of local brain.

SUBKINGDOM.		CLASSES.	
ARTICULATA.	Blood	WHITE; JOINTED LIMBS.	{ RESPIRATION BY TRACHEÆ OR PULMONARY SACS. } Insecta, <i>Insects.</i>
		RED;	{ RESPIRATION AQUATIC, USUALLY BY GILLS; LEGS MORE THAN EIGHT. } Crustacea, <i>Lobsters, etc.</i>
		WITHOUT JOINTED LIMBS.	Vermes, <i>Worms.</i>
SUB-CLASSES.			
INSECTA.	CLASS.	{ DISTINCT HEAD, THORAX, AND ABDOMEN; WINGED, LEGS SIX. }	Insecta proper, } <i>Flies, etc.</i>
		{ SEGMENTS AND LIMBS NUMEROUS, WINGLESS. }	Myriapoda, <i>Centipedes, etc.</i>
		{ HEAD AND THORAX UNITED, LEGS EIGHT, WINGLESS. }	Arachnida, <i>Spiders.</i>

CLASS I. INSECTA.

SUB-CLASS I.—INSECTA PROPER.

General Characteristics.—Insects (*cut into*) have the body divided into three portions—head, thorax, and abdomen. From the head proceed two little stems called *antennæ*, which are supposed to be organs of touch, and perhaps also of sound. The thorax is composed of three rings, each bearing a pair of legs, and the second usually, and the third sometimes, in addition, a pair of wings. The abdomen has typically eleven segments.



*Anatomy of External Skeleton
of a Winged Insect.*

Respiration is effected by a number of breathing apertures, in each side of the body, that open into tubes (*tracheæ*), formed of a spirally-rolled, cartilaginous filament, communicating freely with one another, and, in their last ramifications, penetrating the substance of the organs.

In the wings, where this network of horny tubes is particularly apparent, they are called *veins* and *veinlets*. Inclosing them is a larger tube filled with blood, which is aerated by absorbing air through the membranes of the tubes.

The *Digestive Apparatus* is very complicated, consisting of mandibles, gullet, stomach, crop, gizzard, intestines, etc.

The *Eyes* of most insects are compound, consisting of a multitude of small eyes* (*facets*), each perfect in itself; but

Fig. 349.

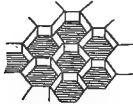


*Trachea of
an Insect.*

* The number of these facets is often enormous—in certain kinds of beetles it exceeds twenty-five thousand, and in the common house-fly it is four thousand.

some have simple eyes (*ocelli*), which are usually placed on the top of the head; and some have both kinds.

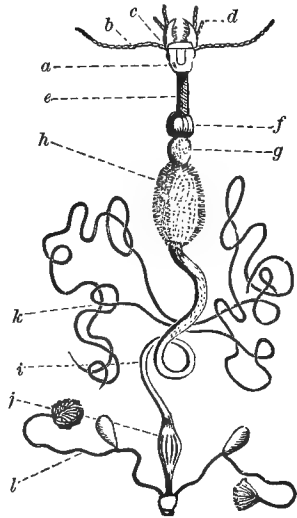
Fig. 351.



Facets of the Eye of an Insect.

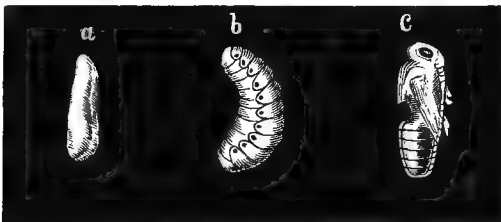
Metamorphosis.—The young insect passes through a series of changes before reaching the form of the adult. Thus, a moth, on emerging from the egg, appears as a *larva*; if with legs, a *caterpillar*; if without, a *grub* or *maggot*. Its whole business now is to eat, and hence in this stage it is most injurious to vegetation. After repeated molts, to allow for the enlargement of its body, it usually rolls itself into a cocoon and becomes a *pupa*, during which stage it remains quiet. At length, the time varying with different species, it bursts forth an *imago*. It is now furnished with wings, and

Fig. 350.



DIGESTORY APPARATUS OF INSECTS.—
 a. Head; b. Antennæ; c. Mandibles;
 d. Palpi; e. Esophagus; f. Crop;
 g. Gizzard; h. Stomach; i. Intestine;
 j. Rectum; k. Biliary vessels; l. Se-
 creting organs.

Fig. 352.



METAMORPHOSIS OF AN INSECT.—a. Egg; b. Larva; c. Pupa.

the two sexes pairing, eggs for the next generation are laid, and the parents die.*

INSECTA. Wings	{	FOUR, MEMBRANOUS.	Hymenoptera,	<i>Bee, Wasp, etc.</i>
		FOUR, SCALY	Lepidoptera,	<i>Butterfly, Moth, etc.</i>
		TWO, IN SOME SPECIES WANTING.	Diptera,	<i>Fly, Mosquito, etc.</i>
		FOUR, TWO HORNY AND TWO MEMBRANOUS.	Coleoptera,	<i>Beetle, etc.</i>
		FOUR GENERALLY, SPARSELY VEINED	Hemiptera,	<i>Cicada, etc.</i>
		FOUR, ANTERIOR THICKENED, STRAIGHT.	Othoptera,	<i>Grasshopper, etc.</i>
		FOUR, NET-VEINED, POSTERIOR GENERALLY LARGEST	} Neuroptera,	<i>Dragon-fly, etc.</i>

ORDER HYMENOPTERA.

General Characteristics.—The Hymenoptera (membrane-winged) have the wings coarsely veined and the anterior pair hooked to the posterior in flight. The females have stings, or *ovipositors*, and the social instinct is highly developed.

Apidæ.—*Honey-bees* are of three sorts—*queens* (females), *drones* (males), and *workers* (imperfectly-developed females).

Fig. 353.



Queen.

Fig. 354.



Drone.

Fig. 355.



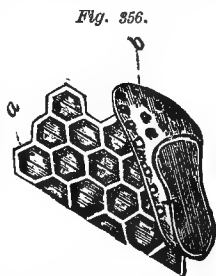
Worker.

In each swarm is one queen, which lays the eggs in three broods: the first producing workers; the second, drones; and the third, queens. The drones are the idlers, and are killed by the workers after the pairing season. The workers are the laborers; some being wax-producers; others, builders; and others, nurses. Honey, wax, and the cement used by

* Although the majority pass through this complete transformation, some are distinguished from the larval state by wings, while others undergo no change except in size from the egg to maturity.

bees to stop up cracks in their hives, are in some mysterious way elaborated out of materials obtained from plants. The various classes of bees are hatched in different-shaped cells, and fed with peculiar food. The workers and drones have horizontal cells, differing only in size; but queen-cells are larger, vertical, and open downward. When the population becomes too large, a portion emigrate (swarm), accompanied by the old queen.*

The *Humble-bees* have two sorts of females—large and small. The eggs of the former produce males, females, and

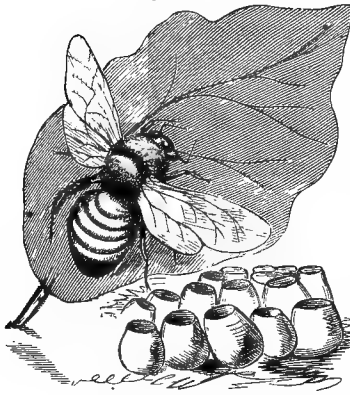


a. Cells of Drones and Workers; b. Cell of Queen.

* A swarm of bees is a carefully-organized community where the division of labor is carried to the utmost limit. In a hive containing about twenty thousand bees there would be one queen, five hundred drones, and nineteen thousand five hundred workers.—The loss of the queen throws everything awry, and if her place is not supplied the hive will perish. A grub is selected, its cell enlarged to royal dimensions, and the stimulating food destined for the queen fed to it. In sixteen days its transformation to a queen will be complete, and it will be ready to assume the royal functions. As but one queen can reign in a hive, the young queens in the royal cells are carefully guarded until it is settled whether there will be new swarms sent off. If not, then the old queen comes in and stings the rest to death. If a swarm leaves under her care, a young queen is released which at once tries to destroy her sisters, but is prevented by the sentinels. If she also departs with a swarm, then a third queen is set free. Finally the reigning queen puts to death her remaining rivals. When a swarm is to start, great preparations are made; scouts are sent out to select a suitable place for the new settlement, and the workers gather food to carry with them. At a signal the queen starts and the rest follow, fighting wherever she stops, and returning if she goes back.—Within a hive all is bustle and hurry, yet all is order. Every outlet is besieged. Hundreds of bees arrive laden with provisions and material. Cautious sentinels scrutinize every arrival. Purveyors, anxious to be away again, stop at the entrance and deliver their loads to other bees. Scavengers clear the hive of everything which would impede the traffic, or injure the health of the inmates. Workers drag out the bodies of their dead companions. Any rash intruder is stung to death, and if he cannot be removed is at once embalmed; if it be a snail that can retire from their attacks within its shell, they cement it close, and its house becomes its tomb.—In making their cells the bees suspend themselves so as to form hanging festoons, which serve as bridges for the workers to pass. One of the bees takes the flakes of wax adhering to the abdomen, moistens it, kneads it with its mandibles, and sticks it to the roof. It then retires and another does the same. Soon shapeless blocks of wax depend. A second set of workers hollow these out and shape them into cells. Meanwhile new ones are being roughly laid, and so the work goes on with marvellous rapidity, a swarm being able to construct four thousand cells within twenty-four hours.—Article on Bees in *Appleton's Cyclopædia*, Wood's "Homes without Hands," Rendre's "l'Intelligence des Bêtes," and Réaumur's "l'Histoire des Insectes."

workers; those of the latter only males.* Late in the

Fig. 357.



Bombus, Humble-bee and cells.

autumn, all die except the large females, which pass the winter in a torpid condition. Awaking in the spring, each sallies forth to seek a convenient place and found a new colony. Within half an hour she will make a cell, store it with pollen and honey, and deposit a few eggs. On hatching, the larva eats the pollen, and shapes for itself a cell. Quickly spinning its cocoon, it passes from a pupa

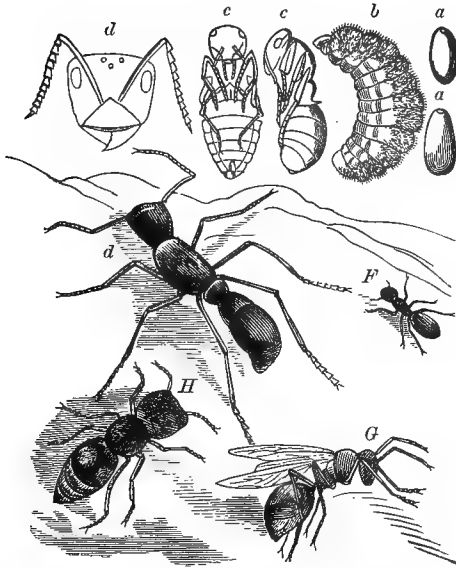
to an imago. Meanwhile the queen continues to lay, and, as fast as the workers mature, keeps them busy in aiding her to build new cells and tend the young.

Formicidæ.—The Ants are a numerous family, over one thousand species having been described. The eggs laid by the last brood of females each summer do not hatch till spring, when they are cared for by the workers that alone, as a rule, hibernate. On a hot day, the winged males and females rise into the air in vast numbers, pair,† and then separate, the males to die, and the females to lose their wings, and, entering the ground, found new colonies.

* The male Humble-bees, like those of the Hive-bee, are harmless and may be known by their white faces. The same is true of the Wasps, which form a family, Vespidæ of the Hymenoptera. They resemble the Bees in their habits. They do not, however, secrete wax; but scraping wood and plants with their mandibles they manufacture a kind of papier maché for building their nests. They thus made paper long before man had learned the art.

† The winged ants have a strong disposition to desert and found new colonies. The workers, however, are on the watch for this, and their sentinels may occasionally be seen dragging back a deserter. Sometimes a party overtaking a queen at a distance from home, do not return but establish a new settlement. The eggs are tended by the queen and the nurses or workers, both eggs and larvæ being brought out into the sun every pleasant day. As they are frequently seen bearing these white-

Fig. 358.



a. Egg; b. Larva; c. Pupa of Ants; d. *Ponera grandis*, Giant Ant;
 F. *Formica sanguinea*, Red Ant; G. *Myrmecia forficata*; H. *Mutilla cephalotos*.

looking grains about, an erroneous idea has arisen that the ants lay up food for winter. The habits of the various species are well worth study. The Agricultural Ants of Texas have a tiny farm, where they cultivate a plant (*Aristida stricta*) whose seed they harvest. The Sanguinary Ants are warriors. They rob their neighbors and reduce their captives to abject slavery, compelling them to do all their work for them, "to lick them, brush them, carry them on their back, and feed them." The Foraging Ants hunt in vast armies, clearing the region they traverse of every wingless insect. They build covered ways for the advance of their columns, and in one case constructed across a chasm a tubular bridge one-half an inch in diameter and twelve inches long. The Leaf-cutting Ants dig wells in search of water, sometimes thirty feet deep. In one place they dug a tunnel under the river Parahyba. In some parts of Brazil they render agriculture almost impossible; they undermine buildings, carry off provisions by night, and strip a tree of all its leaves in a day. The White Ants (a Neuropterous insect, *Termes bellicosus*) of the tropics, erect conical hills twelve feet high, and so strong that the buffaloes use them for watch-towers. They destroy furniture and even houses. They have been known in a single night to ascend a table-leg, eat the contents of a trunk on top, and descend through another leg. The female lays 80,000 eggs in a day, yet in spite of this fecundity their number is kept down, because man and beast alike feed upon them as a dainty. Read Bell's "Naturalist in Nicaragua," *Popular Science Monthly*, July, 1875, Bates's "Naturalist on the Amazon," Figuiet's "Insect World," etc.

Fig. 359.

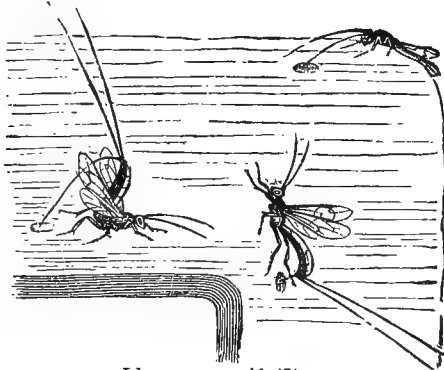
*Cynips quercus-folii*, Gall-fly.

Cynipidæ.—The *Gall-fly* produces the gall-nuts used in making ink. It punctures the leaves and other parts of certain plants, especially the oak, and deposits an egg in the wound, with some irritating fluid that causes the excrescence.

Ichneumonidæ (hunter family).—The Ichneumons number more than six thousand species. Their mission is to prevent the increase of other insects. They are furnished with an auger by which they introduce their eggs underneath the skin of caterpillars. The maggots feed upon the body of their victims. With wonderful discrimination, however, they consume only the adipose part,

and spare its vitals until they are themselves ready to enter the pupa state.

Fig. 360.

*Ichneumon manifestator*,

Ichneumon Fly depositing its eggs in the larvæ at the bottom of the holes.

ORDER LEPIDOPTERA.

General Characteristics.—The Lepidoptera (scale-winged) have wings covered with colored scales, that come off at the slightest touch. These are so minute that four hundred thousand have been counted on a single insect. The larvæ are all Caterpillars, with legs on the thorax and not on the abdomen. The *Butterflies* have knobbed antennæ, and hold their wings upright when at rest. The *Moths* have antennæ feathery and variously shaped, but never knobbed. They usually spin cocoons, the metamorphosis being complete.

Papilionidæ.—The Butterflies* are strictly diurnal, and produce caterpillars destructive to foliage.

Sphingidæ.—The Sphinges (moths) usually fly in the twilight or night. The *Death's-head*

Moth, so called because on the back of its thorax there is a

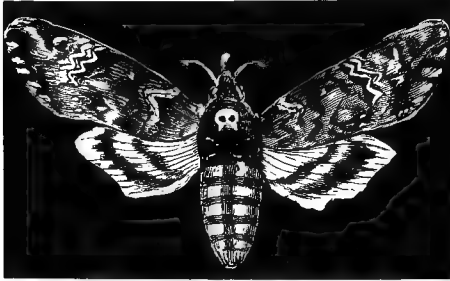
Fig. 361.

*Papilio machaon*, Butterfly.

* Their long, tongue-like proboscis consists of two threads, each a semi-canal, which unite to form a tube for thrusting into flowers to extract their sweet juices. When not in use it can be coiled up like a watch-spring. The Lepidopter's fitting flight aids in escaping its enemies. The number and variety of this beautiful family make it the delight of the student, while the wonderful transformation from the crawling worm to the brilliant insect, affords an ever welcome and touching type of the final release of the soul of man from the darkness of the grave.

rough figure of a human skull, emits a plaintive squeal, when disturbed.

Fig. 362.

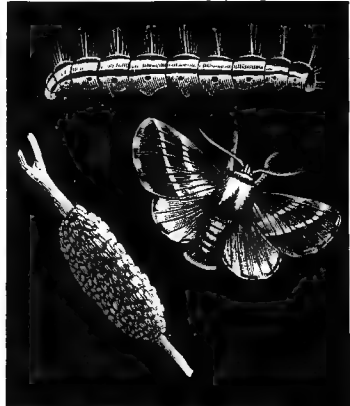
*Acherontia atropos*, Death's-head Moth.

Bombycidæ.—The *Common Silk-worm* spins its thread from a spinneret placed near the mouth. Its cocoon is formed by the larva attaching a few threads lengthwise to adjacent objects, and then turning itself around, thickening the walls with a continuous thread, often one thousand feet long. The *Tent Caterpillar* deposits its eggs in a bunch

Fig. 363.

*Bombyx mori*,
Silk-worm Moth and Cocoon.

Fig. 364.

*Clisiocampa americana*,
Tent Caterpillar. Eggs, Larva, Imago.

around the twigs of trees. The insect, hatching in April or May, weaves a spider-like net, into which it retires at noon and night. As it goes forth to feed, it marks its track by a thread as a clue for its return, and to give a foothold on leaves and smooth places.

ORDER DIPTERA.

General Characteristics.—The Dipters (two-winged) number in North America about ten thousand species. The larvæ are footless maggots, and go through a complete transformation.

Fig. 365.

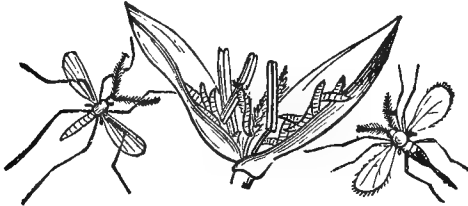


Culex pipiens, Mosquito. Female, Male, and Transformations.

Culicidæ (gnat family).—The *Mosquito* lays its eggs, two or three hundred in number, in the water. On hatching, they become "*Wiggle-tails*." These breathe by means of a long

tube on the last segment of the body, till they change into the pupa state, when respiration is transferred to two tubes in the thorax. Assuming the imago state, they burst through their envelopes, and rise from the water perfect insects. There are three or four generations in a season. The female alone has a piercing proboscis, which for fineness is to the point of a needle as that is to a sword.*

Fig. 366.



Cecidomyia destructor, Hessian Fly; *C. trifici*, Wheat Midge;
Larvæ of latter feeding in wheat-flowers, magnified.

Cecidomyidæ (high-leaping family).—The *Hessian* and the *Wheat Fly* are injurious to wheat, some species by attacking the flower and some the stalk.

Muscidæ.—Flies can walk upon smooth surfaces overhead, because the broad disc of the foot secretes a viscid fluid, by which they adhere. In the imago state there is no growth, so that smaller and larger specimens of flies are different species. †

Fig. 367.



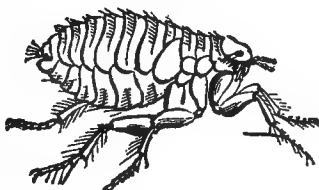
Foot of House-fly.

* Its minute wound should quickly heal; but whether the irritation results from the injection of a poisonous liquid, or from the barbed proboscis, as well as how its hum is produced, are unsettled questions.

† The common House-fly is an importation from Europe, and according to Packard (*American Naturalist*, Aug., 1876) its life may be summed up as follows: "It lives one day in the egg state, hatched in the ordure of stables; from five days to a week as a maggot; from five to seven days in the pupa state, —in all from ten to fourteen days in the month of

Pulicidæ.—The Fleas are wingless Dipters.* They undergo a complete metamorphosis, and the imago possesses rudimentary wings. Their tough skin makes it difficult to crush them between the fingers, while their wonderful muscular power enables them to jump two hundred times their length, and to draw a hundred times their weight.†

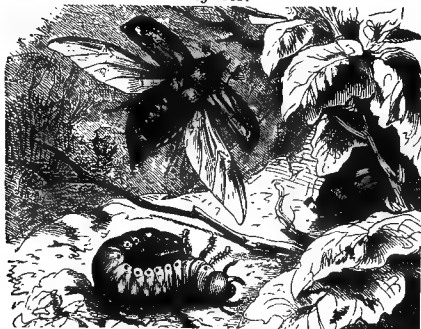
Fig. 363.

*Pulex irritans*, Human Flea.

ORDER COLEOPTERA.

General Characteristics.—The Coleopters (sheath-winged) have the anterior wings (*elytra*)

Fig. 369.

*Lachnosterna fusca*, May-beetle.

of a horny texture, and the posterior, membranous. The latter are the sole organs of flight. The mandibles are very strong, and often armed with acute teeth on the inner margin. Their metamorphosis is com-

August,—before the winged adult period. Most of those which are born in August live for a month or six weeks, and die at the coming of frost. A few probably winter over and survive until mid-summer, and thus maintain the existence of this useful species, to which civilized man owes more than he can readily estimate, and with which he can dispense only when the health of our cities and towns is looked after with far greater vigilance and intelligence than is perhaps likely to be the case for several centuries to come."

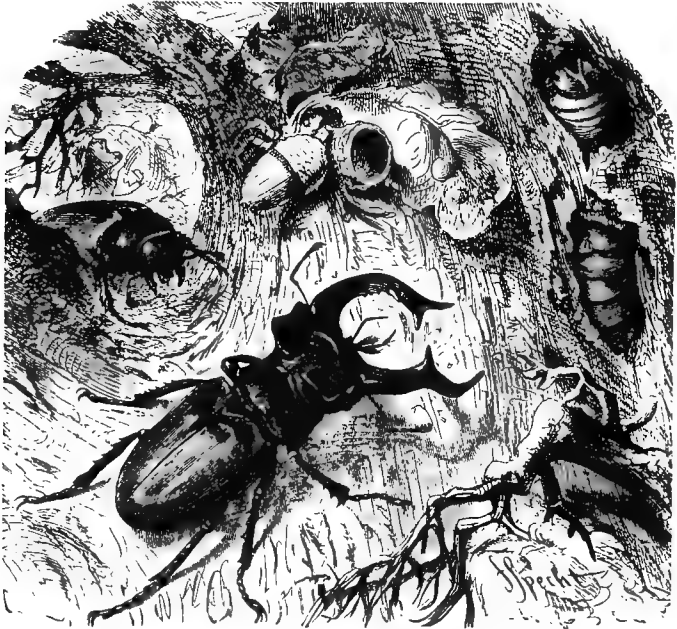
* Horse-ticks, sheep-ticks, bird-ticks, bat-ticks, bee-lice, etc., are other anomalous forms of Diptera.

† Fleas have been trained to show their strength and docility. The so-called "learned fleas," exhibited in Paris, went through military evolutions, standing on their hind legs and shouldering tiny spears: and two of them drew a companion in a little wagon, a fourth sitting on the coachman's box and wielding the whip. The spectators viewed this wonderful exhibition through magnifying glasses.

plete, the soft larvæ usually having a horny head with simple eyes and distinct jaws.

Scarabæidæ (cased).—The *May-beetle*, or *Dor-bug*, lays its eggs in the ground during May or June. They hatch in about three months. The larva, called by farmers the "white-worm," grows to the size of the little finger, devouring voraciously every kind of vegetable. After remaining some years in this state, passing the winter in the ground below frost, it changes to a pupa, emerges a beetle, lays its eggs, and dies.

Fig. 370.



Lucanus cervus, Stag-beetle, Europe.

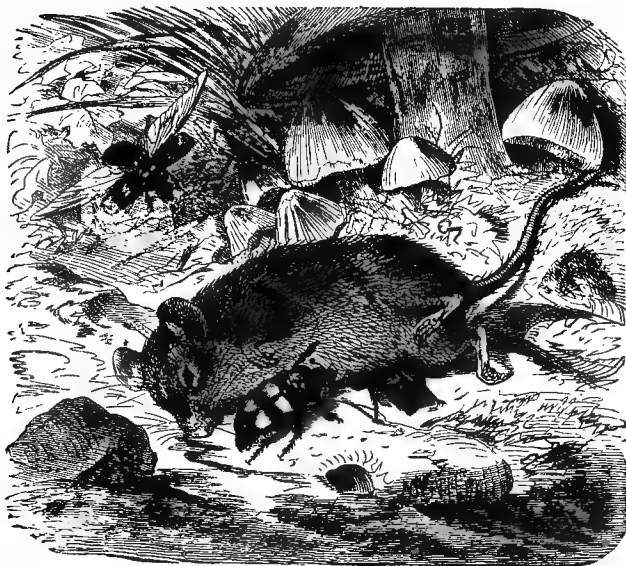
Lucanidæ.—The *Horn-bugs** lay their eggs under the

* So strong are the jaws of Stag-beetles that one has been known to gnaw a hole an inch in diameter through the side of an iron canister.

bark at the roots of trees, and their metamorphosis goes on within the trunk.

Silphidæ.—The *Burying-beetles* dig underneath small

Fig. 371.



Necrophorus vestigator burying a Mouse.

dead animals—mice, birds, etc.—and soon bury them as provision for their young.

Cerambycidæ.—The *Long-horns* have filiform, recurved antennæ, often much longer than the body. Their eggs are laid in crevices of bark, and the larvæ bore into the hardest wood, oftentimes destroying whole forests. To this family belongs the destructive “apple-tree borer.”*

Scolytidæ.—The *Bark-borers* cause great devastation among trees by digging, just beneath the bark, radiating

* To the family Chrysomelidæ belongs the Striped Squash Beetle (*Diabrotica vittata*), a yellow bug which attacks the vines as soon as they are up.

Fig. 372.



Cerambyx moschatus,
Long-horned Musk Beetle.

Fig. 373.



Scolytus destructor,
Bark-borer.

galleries bearing a rude resemblance to written characters, an egg being placed at the termination of each gallery.

Fig. 374.

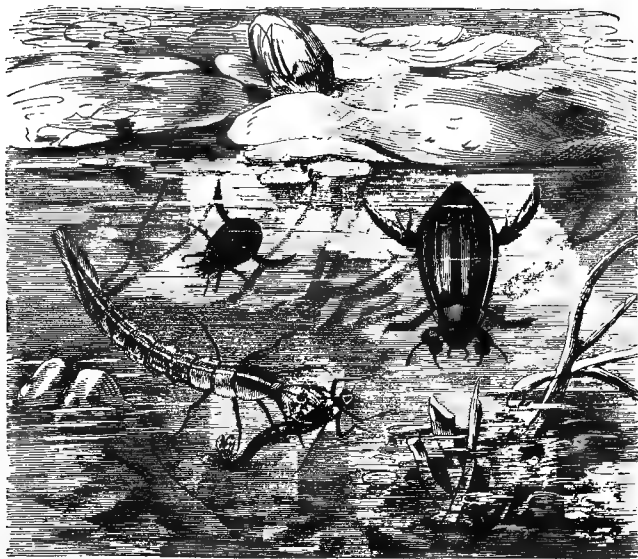


Brenthus nasivus, Curculio.

Curculionidæ.—The *Weevils* have a long proboscis for boring holes in which to deposit their eggs. Different species attack every part of a plant. The *Plum-weevil* makes a crescent-shaped incision into a plum, and its egg hatches a whitish grub that soon penetrates to the kernel of the fruit. *Brenthus* attacks hazel-nuts.

Dytiscidæ.—The *Water-beetles* are oval in form, and have strongly-fringed hind-legs for swimming. The larvæ are called “*Water-tigers*,” as their scissor-like jaws enable them to snip off the tails of tadpoles, and even hold on to young fishes while sucking their blood. On assuming the pupa state, they

Fig. 375.



Dytiscus fasciventris, Water-beetle and Larva of Water-beetle. "Water-tiger."

crawl upon the land, construct a round cell, and come forth as beetles.

ORDER HEMIPTERA.

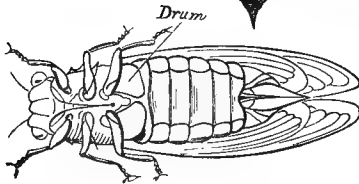
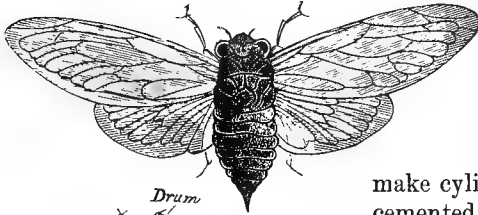
General Characteristics.—The Hemipters (half-winged) have fore wings half leathery and half membranous; usually both ocelli and compound eyes; and a suctorial mouth. The metamorphosis is incomplete.

Cicadidæ.—The Harvest-fly family includes the "Seventeen-year Locusts."* The females, with a saw-like ovipositor, furrow the twigs of both forest and orchard trees longitudinally to the length of fifteen or eighteen inches, piercing every two-thirds of an inch to the pith, and depositing two

* They appear in different localities annually, but in any one only once in seventeen years. C. V. Riley states that there is a "Thirteen-year Locust."

eggs, side by side, with a thin layer of woody fibre between. The larvæ, on hatching, drop to the ground, in which they

Fig. 376.



Cicada septendecim, "Seventeen-year Locust."

live for seventeen years, feeding upon the roots of trees. When ready to enter the pupa state, they make cylindrical burrows, cemented water-tight, and at length issuing forth, in appearance like the imago except the want of wings, attach themselves to any object at hand, particularly the trunks of trees. In a short time, the thorax splitting on the back, the perfect imago crawls out; after pairing, the female deposits its eggs, and the male fills the air with the noise of the ear-piercing kettle-drum beneath its wings.*

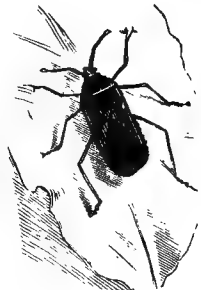
Coreidæ.—The *Squash-bug* hibernates in crevices, but lays its eggs on the under side of squash leaves. The young brood are of a pale ash color, and, after molting several times, appear in their perfect state with wings and wing-covers.

Aphidæ (exhausters).—*Plant-lice* † have a wonderful life-history. The eggs

live for seven-
teen years, feed-
ing upon the
roots of trees.
When ready to
enter the pupa
state, they

make cylindrical burrows,
cemented water-tight, and
at length issuing forth, in
appearance like the imago
except the want of wings,
attach themselves to any
object at hand, particular-
ly the trunks of trees. In a

Fig. 377.



Coreus tristis,
Squash-bug.

* This apparatus is concealed under two valves in the upper part of the abdominal cavity. The membrane of the drum-head is thin, brittle, and slightly wrinkled. There is a muscle attached to it on the inner side. By contracting this, the drum-head is drawn in, but on relaxing, it springs back of itself, thus producing the familiar clicking noise of the Cicada. The pupil can easily make a dissection of the insect, and examine the apparatus for himself.

† Nothing can be more amusing than to watch the plant-lice for half an hour,

deposited on the plants in the autumn hatch in the spring asexual and wingless individuals. These produce living young, likewise asexual, in succession, often to the twelfth generation. At the close of summer, winged and sexual ones appear. These pairing, their eggs do not hatch until the following spring. This method of propagation is called *Parthenogenesis*. It has been calculated that a single *Aphis* will produce a billion young in a summer. One species (*Eriosōma lanigēra*), covered with a woolly, flocculent substance, causes the apple-blight by stinging the bark, when the leaves turn yellow and drop off.

Fig. 378.



Aphis rosea,
Rose Louse, magnified.

Fig. 379.



Acrydium aleutacum, Leather-colored Locust (upper figure).
Cyrtophyllus concavus, Katydid (lower figure).

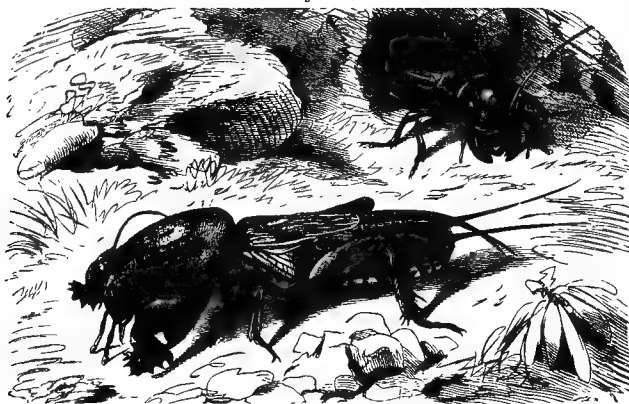
while gorging themselves with the honey extracted from the tender bark, and observe the treatment they receive from the ants, which keep them, as we do cows, extracting from them a sweet liquid of which they are very fond.

ORDER ORTHOPTERA.

General Characteristics.—The Orthopters (straight-winged) have strong, horny, and toothed mandibles for biting. The anterior wings are of a leathery texture; the posterior, membranous and folding, like a fan. The legs vary much in form and size, in some families the anterior pair being greatly enlarged for seizing, and in others the posterior for leaping. The metamorphosis is incomplete, the young resembling the parents, except in size and the want of wings.

Locustidæ.—The *Katydid* is silent during the day, but musical throughout the night. Its familiar notes are produced by the friction of the bases of the wings upon each other.

Fig. 380.

*Gryllotalpa vulgaris*, Mole Cricket.

Gryllidæ.—The *Mole Cricket* has its anterior extremities shaped like those of the mole, for constructing subterranean galleries.

Acrydidæ.—The “*Grasshoppers*,” or Locusts of the Western States, belong to this family. They come in such multitudes as to give sunlight the yellow tinge of dense smoke, and to eat a large field of grain in an hour.

Forficulidæ.—The *Earwig** sits upon its eggs till they are hatched, and then broods its young as a hen does its chickens.

ORDER NEUROPTERA.

General Characteristics.—The Neuroptera (nerve-winged) have an elongated body with four membranous wings of beautiful network, minutely subdivided. The metamorphosis is not always complete. None

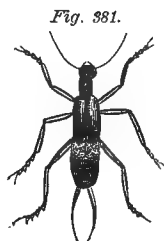


Fig. 381.
Forficula auricularia,
Earwig.

of them are injurious to living plants.

Libellulidæ.—The *Dragon-fly* (or Devil's Darning-needle) has very large compound eyes and also three ocelli on the top of the head. It feeds upon mosquitoes, flies, etc. It has no sting, and is perfectly harmless. The larvæ pass through their transformations in the water.

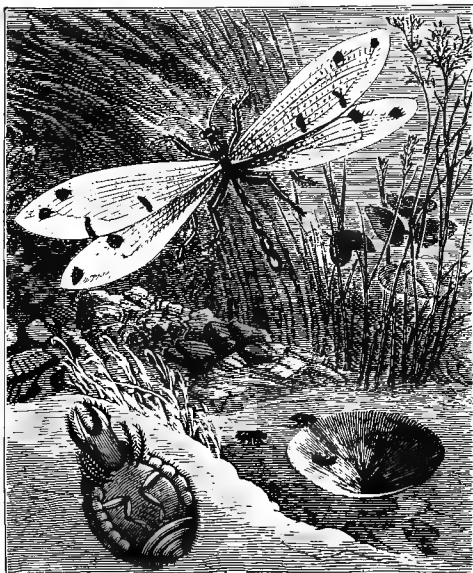


Fig. 382.
Libellula depressa, *Calopteryx virgo*,
Larva of Dragon-fly.

Myrmeleonidæ.—The *Ant-lion* in repose folds its wings like a roof upon the sides of the body. The larvæ dig funnel-shaped pitfalls in the sand, and lie concealed at the bottom, snapping up any insect that tumbles in, and even tossing a shower of sand to destroy the foothold of any victim that tries to escape up the sloping sides. (Fig. 383.)

* This insect must not be confounded with the "Thousand-legs," which bears the same popular name. The term Earwig should be Ear-wing, their large wings when expanded having the shape of ears.

Fig. 383.



Myrmelion obsoletus, Larva, Imago and Pit-fall of Ant-lion.

HINTS FOR PRESERVING INSECTS.

A small hand-net, which can be easily made of gauze by any pupil, will be of great use in catching insects. Butterflies may be killed by a gentle squeeze under the wings, or better by a drop of chloroform or ether applied with a camel's-hair brush to the proboscis or the sides of the abdomen. Beetles should be dropped into alcohol, ether or benzine; when dead, they may be taken out and a pin thrust through the right wing-cover near the thorax. Pin other insects through the middle of the back, fastening the wings in place, if large, with strips of paper pinned across each one. When dry, transfer to a tight shallow box with a glass cover. Bits of camphor-gum kept in the box will prevent the ravages of *Dermestes* and *Anthrenus*. (See Index.)

SUB-CLASS II. MYRIAPODA.

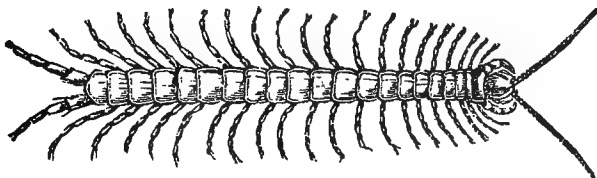
General Characteristics.—The Myriapods (ten-thousand-footed) are worm-like in appearance, and have the head free and the thorax merged in the abdomen.

MYRIAPODA.	{	EACH SEGMENT WITH A SINGLE PAIR OF FEET.	}	Chilopoda,	<i>Earwig, Centipede, etc.</i>
		EACH SEGMENT WITH TWO PAIRS OF FEET.		}	Diplopoda,

ORDER CHILOPODA.

General Characteristics.—The Chilopods (lip-footed) are distinguished for their predatory habits and venomous bites. They feed upon earth-worms.

Fig. 384.

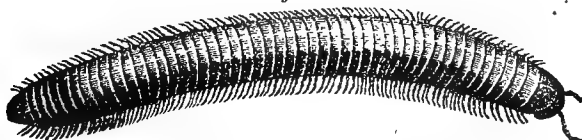
*Scolopendra gigantea*, Centipede. $\frac{1}{2}$.

Scolopendridæ.—The well-known *Centipede* of the Southern States is the type of this family.

ORDER DIPLOPODA.

General Characteristics.—The Diplopods (double-footed) have the mouth modified for eating plants. They

Fig. 385.

*Julus canadensis*, Thousand-legs. $\frac{1}{2}$.

are harmless, and beneficial in destroying dead vegetable matter.

Julidæ (down-like).—The “*Thousand-legs*” being slow-moving, when alarmed, coils its body in a ring, with the tail in the centre and the feet entirely concealed.

SUB-CLASS III. ARACHNIDA.

General Characteristics.—The Arachnids (spider-like) have the head and thorax amalgamated; ocelli from two to eight; and four pairs of legs. They molt six times in coming to maturity, but undergo no metamorphosis.

ARACHNIDA.	{	ABDOMEN WITHOUT SEGMENTS AND JOINED BY A SLENDER PEDICEL TO THE CEPHALO-THORAX.	} Araneæ, <i>Spider</i> .
		ABDOMEN WITH SEGMENTS AND INDISTINCTLY UNITED TO THE CEPHALO-THORAX.	} Pedipalpi, <i>Scorpion, etc.</i>
		ABDOMEN WITHOUT SEGMENTS AND MERGED WITH THE CEPHALO-THORAX.	} Acarina, <i>Mite, etc.</i>

ORDER ARANĒÆ.

General Characteristics.—Spiders have neither compound eyes nor antennæ. They possess a prehensile organ, with a hook at the end, through which issues a poison fatal

Fig. 386.



Spider's Thread.

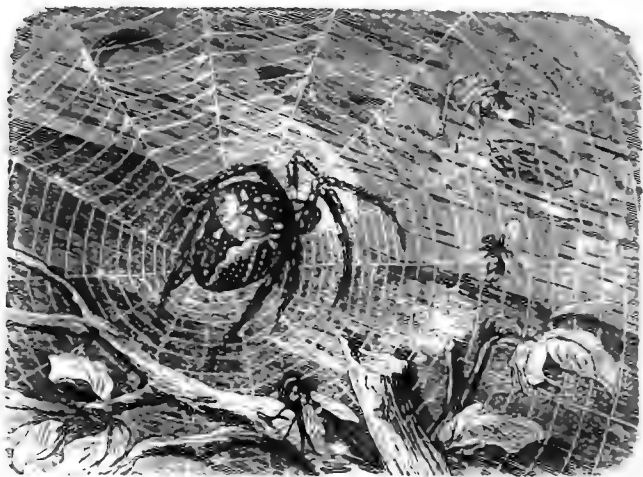
Fig. 387.



Spider's Claw.

to the animals upon which they feed.* At the posterior extremity there are four to six projections, *spinnerets*, pierced oftentimes with a thousand holes, through which flow little streams of gluey matter, that harden on exposure to the air, and uniting, form a single thread.† Some species emit the threads freely into the air, till their buoyancy will sustain them in a balloon-flight, or, the ends adhering to some distant object, a bridge is formed by which they can pass over streams and ditches.

Fig. 388.

*Epeira diadema*, Geometrical Spider.

Araneidæ.—The *Geometrical Spider* is so called from the regularity of the radiating and circular lines of its web.

Mygalidæ.—The *Mason Spider* constructs a subterranean

* This is injurious to man only when the system is predisposed to erysipelas, etc., even a mosquito bite then being poisonous.

† The union of the threads is effected by a skillful manipulation of the hind feet, the comb-like structure of the claws being peculiarly adapted for this purpose. The silk of some genera is produced in great quantity. Thus Dr. B. G. Wilder wound several miles of threads from the spinnerets of the *Nephila plumipes* found near Charleston. See *Harper's Magazine*, vol. xxxiv, p. 460; also vol. xxii, p. 323.

residence. This is closed with a water-tight trap-door, having an elastic hinge, the outside mimicking the soil around, and held down with the whole force of the spider's claws fastened on the side of the door opposite the hinge.

Fig. 389.

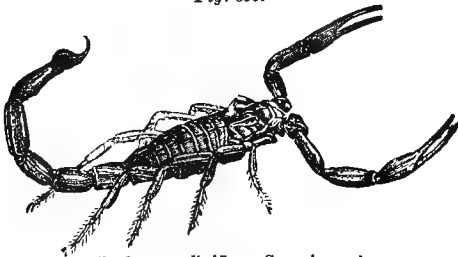
Nest of *Mygale*.

ORDER PEDIPALPI.

General Characteristics.—The Pedipalpi (foot-feelers) have large maxillary palpi and the jointed abdomen prolonged sometimes into a tail.*

Scorpionidæ.—The *Scorpion* has a powerful poison-sting at the end of its tail-like abdomen, which wounds by curving

Fig. 390.

*Buthus carolinianus*, Scorpion. $\frac{1}{2}$.

over the back, while the victim is held between the forceps-like feelers. Its wounds are rarely fatal, the antidote being hartshorn.

ORDER ACARINA.

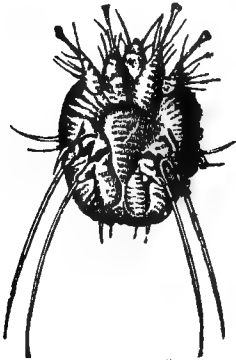
General Characteristics.—The Acarina have the mouth adapted either for sucking or biting. They are of small size, and generally parasitic.

Acaridæ.—The *Itch-mite*, burrowing in the flesh, multi-

* The Phalangidæ include the Harvest-man or "Daddy-long-legs" (not the crane-fly), which is carnivorous, feeding especially upon the Aphidæ, and is hence very beneficial.

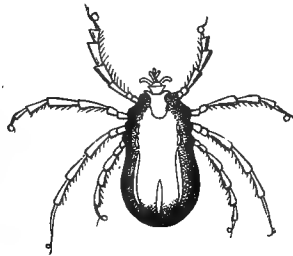
plies rapidly, and produces the loathsome disease to which it gives name.

Fig. 391.



Sarcoptes scabiei,
Itch-mite, magnified.

Fig. 392.



Ixodes bovis, Western Cattle Tick.

Ixodidæ.—*Ticks* infest man and beast in great variety. Quickly burying themselves beneath the skin, they cannot readily be extracted without leaving behind portions of their claws, which, if allowed to remain, soon produce inflammation and serious ulcers.

CLASS II. CRUSTACEA.

General Characteristics.—The Crustaceans (hard-covering) are articulate animals with jointed appendages and essentially aquatic respiration. The body typically consists of twenty segments, though some species have sixty and some only ten. The hard exterior crust not yielding for growth, frequent moultings are necessary, which are effected by the shell splitting open, generally on the back, and the animal crawling out. The heart, when it exists, is on the back, immediately under the shell. The nervous system lies on the under surface. In their growth from the egg they undergo the most astonishing changes, the young in no way resembling the adult. The Crustacea are mostly marine; some, however, live in fresh water, and a few in damp places on the land.

Fig. 393.



1. *Cancer pagurus*, Edible Crab.

2. *Sea Anemone*.

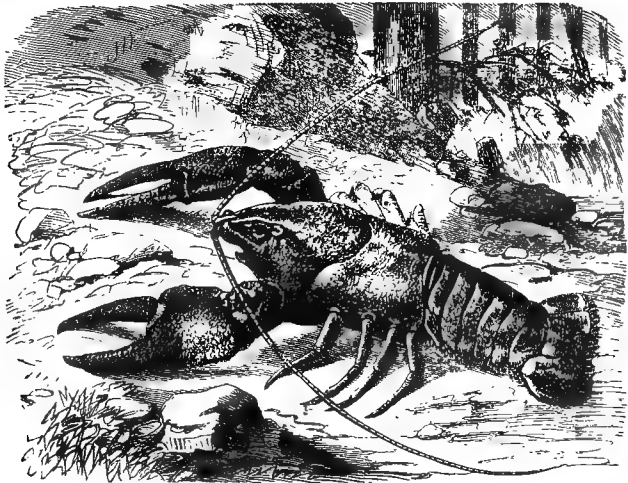
3. *Serpula*.

CRUSTACEA.	{	LEGS TEN.	Decapoda,	<i>Crab, Lobster.</i>
		LEGS FOURTEEN.	Tetradecapoda,	<i>Beach Flea.</i>
		LEGS LAMELLATE.	Phyllopoda,	<i>Brine Shrimps.</i>
		LEGS ABORTED.	Siphonostoma,	<i>Fish Lice.</i>
		ANIMALS ATTACHED.	Cirripedia,	<i>Barnacle.</i>
		LEGS ANSWERING FOR JAWS.	Merostomata,	<i>Horse-shoe Crab.</i>

ORDER DECAPODA.

General Characteristics.—The Decapods (ten-footed) have the anterior portion of the body covered with a single piece called the *carapax*, the gills attached to the anterior feet, and the eyes situated on movable peduncles.

Fig. 394.

*Astacus fluviatilis*, Cray-fish or River Lobster.

The **Brachyura** (short-tailed) have the abdomen small and folded under the thorax. The anterior pair of feet are furnished with pincers. The Crab (Fig. 393) is an example.

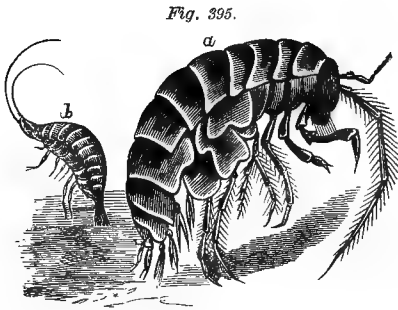
The **Macrura** (long-tailed) have, as in the *Lobster* and *Cray-fish*, the abdomen large and extended.*

* The Fiddler Crab when alarmed holds up in front its big claw in a threatening way. The Sand Crab runs to its hole so swiftly as to be overtaken with difficulty. The

ORDER TETRADECAPODA.

General Characteristics.—The Tetradecapods (fourteen-footed) have sessile (low-sitting) eyes and all the segments of the thorax free.

The Amphipods have the four anterior pairs of feet directed forward and the three posterior backward. They live in both salt and fresh water, and are abundant on the sea-shore between tide-marks. (Fig. 395.)

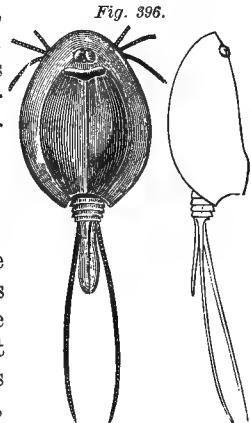


a. *Talitrus locusta* ;
b. *Orchestia longicornis*, Sand-fleas.

The Isopods have a flattened body, the three anterior pairs of feet directed forward and the four posterior pairs backward. The gills are borne under the abdomen. *Sow-bugs* are familiar examples.

ORDER PHYLLOPODA.

General Characteristics.—The Phyllopods have from 10 to 60 pairs of leaf-like feet, answering the purpose of gills. They are found in both salt and fresh water. Fig. 396 represents a species discovered by Dr. E. Coues, in small prairie pools in Montana.



Lepidurus couesii.

Hermit Crab is protected only in front, and so "backs" into the spiral shells of other Mollusks, leaving its temporary home only when outgrown. The Marine Lobster has a broad fin at the base of its tail, by one stroke of which it can spring backward twenty feet.

ORDER SIPHONOSTOMA.

General Characteristics.—The Siphonostoma (sucking-mouth) in their early stages have eyes, jointed limbs, and swim freely, but when adult they are attached to fish, and live mainly on the mucus which covers their host. A permanent hold is secured by insinuating their barb-like head into the flesh, often the eye. (Fig. 397.)

Fig. 397.



Lernæonema spratti,
Sprat-sucker, attached to eye of Sprat.

Fig. 398.



Balanus crenatus, Acorn Barnacle.

ORDER CIRRIPIEDIA.

General Characteristics.—The Cirripeds (curl-footed) in their early stages have eyes, antennæ, and limbs. After swimming about for a while they attach themselves to any solid substance, the eyes become rudimentary and the antennæ obsolete. The thoracic feet by constant motion create currents of water which float food to the animal's mouth.

Balanidæ.—The *Acorn Barnacle* is sessile, the shell

containing the soft parts being cemented directly to a rock, a pile, or a ship's bottom. It consists of a short tube with a lid of four pieces between which the feet (cirri) are thrust when in search of food. (Fig. 398.)

Fig. 399.



Shell of Barnacle.

Fig. 400.

Body of Cirriped
or Barnacle.

Lepadidæ. — The *Stalked Barnacle* is pedunculate, having the shell (capitulum) containing the soft parts on the extremity of a long flexible stem. In cleaning the hull of the Great Eastern several years ago, over three hundred tons of barnacles were

found attached to it. (Figs. 399, 400, 401)

Fig. 401.

*Lepas anatifera*, Stalked Barnacles.

ORDER MEROSTOMATA.

General Characteristics.—The Merostomata (thigh-mouths) have the limbs placed around the mouth and use the basal joints for jaws, whence the name of the order.

Limulidæ.—*Limulus*, the *Horse-shoe Crab*,* is the only

Fig. 402.

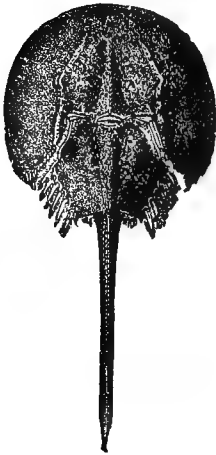
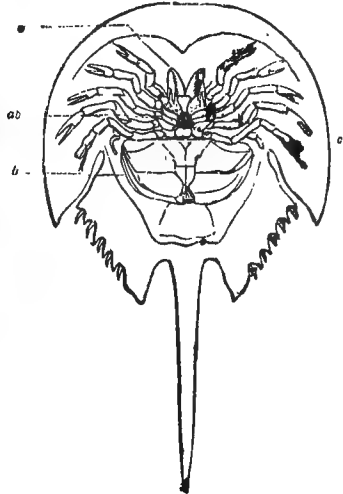


Fig. 403.

*Limulus mollucanus*, Horse-shoe Crab. $\frac{1}{2}$.Under Surface of *Limulus*.

genus now living. When moulting, the shell splits along the anterior border and not down the back as in other Crustacea.

CLASS III. VERMES.

General Characteristics.—The Vermes (worms) are articulated animals without jointed limbs, their place being supplied in some by bristles. The blood is generally red and

* The Trilobites, which figure so largely in Palæozoic Geology, were nearly related to the Horse-shoe Crab. (Figs. 402, 403.)

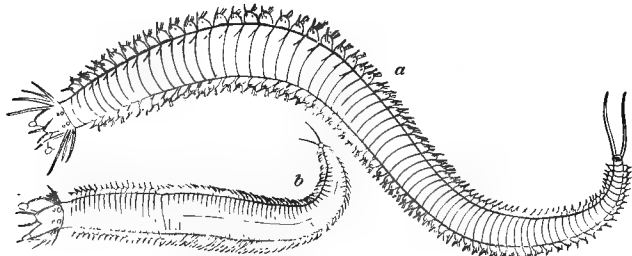
respiration is effected in some by gills and in others by the whole surface of the body. Eyes are occasionally found. Worms exist everywhere, in salt and fresh water, and on land, and as parasites in man and other animals.

VERMES.	{	Mostly aquatic.	{	WITHOUT CILIATED DISCS.	Annulata,	<i>Nereis.</i>
				WITH CILIATED DISCS.	Rotatoria,	<i>Rotifer.</i>
	Mostly parasitic.	{	ROUND.	WITH SPINES.	Acanthocephalix,	<i>Echinorhynchus.</i>
			FLAT.	WITHOUT SPINES.	Nematelminthes, Platyelminthes,	<i>Trichina.</i> <i>Tape-worm, etc.</i>

ORDER ANNULATA.

General Characteristics.—The *Annulata* have red blood, a nervous system resembling that of insects, and the alimentary canal extending the whole length of the body. The body is elongated and the segments are distinctly marked. Some are furnished with bristles, others are without; some have gills, others have none.

Fig. 404.



Nereis pelagica. a, Male; b, Female. Natural size.

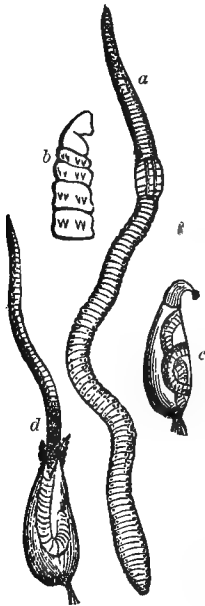
The *Nereidæ* have both bristles and gills arranged on each side of the body, and the mouth is armed with powerful jaws.

The *Serpulidæ* (see Fig. 393) are marine, with gill-tufts around the head. Some live in calcareous tubes variously contorted, adhering by the closed end to oyster-shells, etc., but protruding from the open end brilliantly-colored, fan-like appendages, with one dilated to close the shell when the

animal is withdrawn into the tube. Other worms nearly allied to *Serpula* form a tube by cementing together grains of sand and bits of broken shells.

The *Lumbricidæ* (Common Earth or Angle-worms) are wanting in gills, but minute apertures on the sides communicate with internal respiratory sacs, on the walls of which the blood circulates for aëration. Tiny spines directed backward enable the worm to force its way through the

Fig. 405.



a. *Lumbricus terrestris*, Angle or Earth-worm. b. Anterior segments magnified, showing bristles directed backward; c. Egg, enclosing two young; d. Escape of young from egg.

Fig. 406.



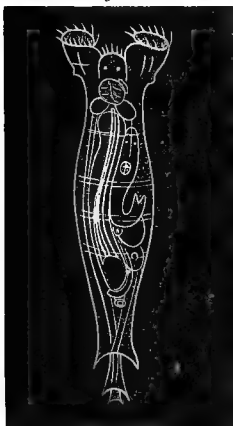
Hirudo medicinalis, Leech, Europe.

earth. Digesting the organic matter in the dirt it eats, the

rejected "worm-casts" are of service in the garden, and often cover barren tracts with a layer of productive mould. It is oviparous—a single egg frequently containing two embryos.

The *Hirudinidæ* (Leeches) are aquatic without bristles or gills. They are used in medicine for bleeding, France alone using a hundred million annually. A saw-like movement of their tri-radiate jaws readily cuts the skin, and with the aid of the vacuum produced by the sucker, causes a copious flow of blood. So slow is its digestion that a single meal will answer for a year. Over thirty species are known to inhabit the fresh waters of North America. (Fig. 406.)

Fig. 407.

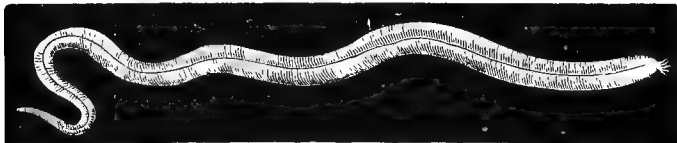
*Rotifer vulgaris.*

Wheel Animalcule, greatly magnified.

ORDER ROTATORIA.

The *Rotifers* (wheelbearers) are aquatic and microscopic, seldom exceeding one thirty-sixth of an inch in length. Anteriorly they have one or two discs surrounded by cilia, whose rapid motion produces the optical illusion of revolving wheels. They are oviparous, and, according to Ehrenberg, one species multiplied in twelve days, to sixteen millions, as "determined by actual experiment." The upper and lower segments shut together like a telescope, and the animal often assumes a spherical shape. By some the Rotifers are considered Crustacea.

Fig. 408

*Echinorhynchus gigas*, Spine-headed Worm.

ORDER ACANTHOCEPHALI.

Acanthocephalidæ.—The *Acanthocephali* (spine-headed) are represented by *Echinorhynchus*, a parasite found in

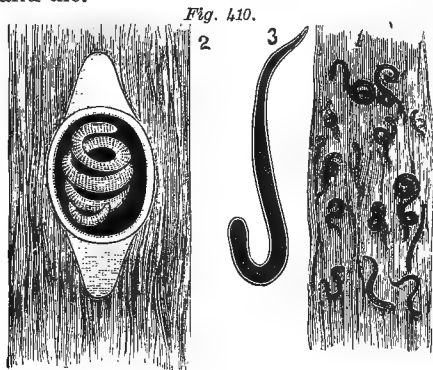
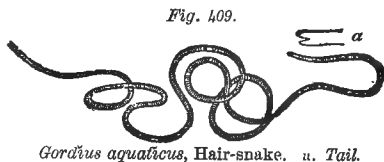
the alimentary canal of the hog. Its proboscis is retractile and is armed with four circlets of sharp, recurved spines surrounding a simple suctorial mouth. (Fig. 408.) *Koleops* is another genus found in the eel.

ORDER NEMATELMINTHES.

General Characteristics. — The Nematelminthes (thread-like worms) are parasitic during a portion of their lives in the interior of various animals. The head is without a circle of hooks and the sexes are separate.

Gordiidæ.—The *Hair-snake* is so called from the erroneous notion that it originates from horse-hairs soaked in water. Probably, by the eggs being eaten, the larvæ

obtain access to the bodies of grasshoppers, etc., and, coiling up within the cavity, reach a length oftentimes tenfold that of their host. At maturity, they desert the insects at whose expense they have been nourished, and seek the water to lay their eggs and die.



Trichina spiralis, Muscle-worm.
1. Migrating in muscles; 2. Encysted; 3. Free state.

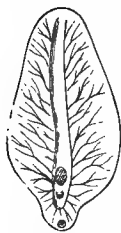
Trichinidæ (hair-worms).—The *Trichina* is parasitic in

swine. Leaving the intestines by boring through the walls, it lays its eggs in the muscular tissues. Portions of this infected meat eaten raw in Bologna sausages or ham, may transfer the eggs to be hatched in the intestines of man. There they multiply, and the embryos, penetrating the walls of the alimentary canal, work their way through the muscles. The victim suffers great pain and shows symptoms like those of the typhoid fever. If he can endure this migration of the trichinæ, they become after a time encysted, and he is safe, since they cannot mature until transferred to some other animal. By thoroughly cooking pork the trichina is destroyed.

ORDER PLATYELMINTHES.

General Characteristics.—The Platyelminthes (flat-worms) are mostly parasitic, being found in the viscera or muscles of various animals. They are without bristles and the segments of the body are indistinct.

Fig. 411.



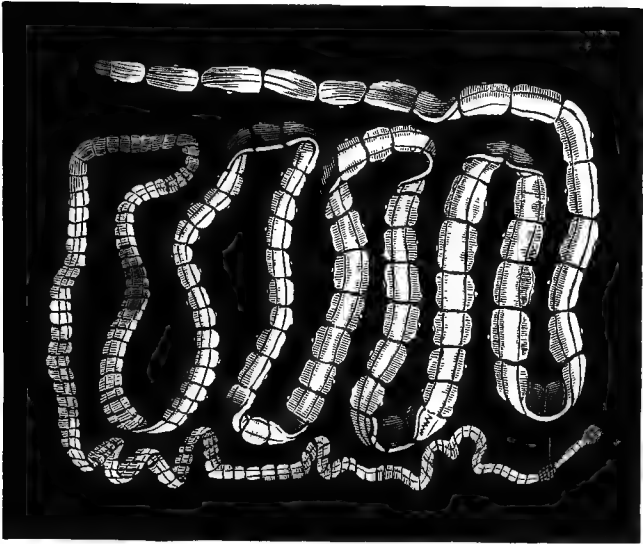
Distoma hepaticum,
Liver Fluke.

Distomidæ (double-mouthed).—The *Fluke* has one or two suckers by which it adheres. The alimentary canal divides behind the mouth, and terminates in blind extremities. This parasite is found in the liver of sheep and deer, producing the disease called “rot.”

Cestoididæ (ribbon-shaped).—The *Tape-worm* of the human system is sometimes more than twenty feet long. The anterior extremity is furnished with hooks and suckers for anchoring to the intestines of its victim; but, so far as appears, there is no mouth or digestive organs,

and the worm seems to derive its nourishment entirely by absorption through the skin. It grows by new joints formed next to the head. The older ones ripen and fall off. Each of these can move, and contains a multitude of eggs, which, on escaping to the outer world, it scatters far and wide. The eggs are oftenest swallowed by the hog, that omnivorous feeder. In its stomach they hatch, and the embryos, boring

Fig. 412.

*Taenia solium*, Human Tape-worm.

their way into the blood-vessels, are swept to all parts of the system. Entering the organs, they become surrounded by a cyst or crust. When "measly pork," *i. e.*, pork thus infested, is eaten, the vesicle bursts and the worm is rapidly developed.*

Planariidæ (flat-formed). — The Planaria is of gelatinous consistency, and not parasitic. Any portion amputated is reproduced in a brief time.

Fig. 413.



Planocera nebulosa,
Planarian Worm,
magnified double.

* The life-history of the tape-worm is always the same. Some animal eats the eggs and develops the larvæ; another eats its flesh and develops the mature worm. The other common tape-worm of man is derived from "measly" beef. The tape-worm of the cat comes from the cystic worm of the mouse; that of the fox from the cystic worm of hares and rabbits; and that of the dog from the cystic worm which causes the "staggers" in sheep.

The Articulata are divided by many Naturalists into two groups, the Arthropoda (including the Insecta and Crustacea) and the Vermes. The former are characterized by the presence and the latter by the absence of jointed appendages.

The classification of the Vermes is still in an unsettled state, very little being known concerning the lower forms, and almost every Naturalist holding views of his own.

HINTS FOR PRESERVING INSECTS, CRUSTACEA, Etc.

Prof. Packard, in his "Guide to the Study of Insects," recommends preparing a wide-mouth collecting bottle by putting two or three small pieces of cyanide of potassium (pupils should remember that this is very poisonous) in the bottom and covering with perforated paper. Insects of every kind dropped in, die instantly. A bottle well-prepared will last for months. The nests, cocoons and chrysalids of insects may be preserved from injury from other insects by being soaked in arseniated alcohol, or dipped into benzine, or a solution of carbolic acid or creosote. "Setting-boards" for spreading the wings may be made by sawing in a thick board deep grooves of varying widths, and glueing at the bottom of each a strip of cork or pith. The body of the insect having been placed in a groove and the wings set horizontally, square pieces of glass may be laid upon them until they are dry. Bottles containing sponges saturated with benzine should be kept in the cases containing the specimens.

All crustacea may be preserved by drying, after eviscerating the larger specimens. Caterpillars may be preserved with the colors unchanged, according to Mr. E. Burgess, by immersing them in boiling water thirty or forty seconds, and then placing them in equal parts of alcohol and water. Worms must be kept in spirit. Starfishes and all the echinoderms die instantly on being immersed in fresh water.

III. SUBKINGDOM MOLLUSCA.

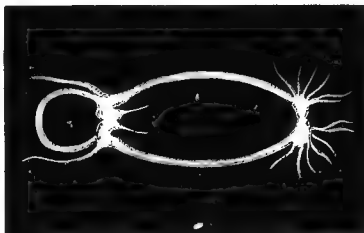
General Characteristics.—The Molluscans (soft-bodied) have yielding tissues of great contractile power, inclosed in a soft flexible skin called the *mantle*.

The nervous ganglia are placed irregularly, but all communicate with a larger mass forming around the throat a ring, which may be considered the brain.

Except in one class, the muscles are attached to the skin, which is usually protected by a shell consisting principally of carbonate of lime,

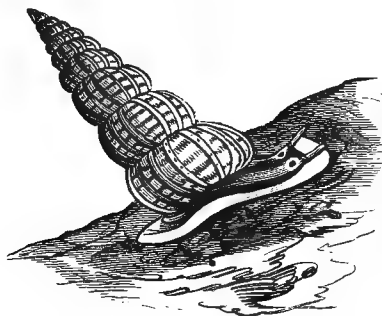
which in turn is defended by an epidermis of animal matter, to prevent corrosion by the water. The blood is white, and

Fig. 414.



Nervous System of a Mollusk.

Fig. 415.



A Mollusk.

the circulation effected by means of a distinct heart. Mollusks are mostly oviparous.

		CLASSES.		
MOLLUSCA.	{	Mollusca vera	HEAD AND FOOT PRESENT; {	BI-LATERALLY SYMMETRICAL; FEET AROUND THE HEAD. } Cephalopoda.
			HEAD ABSENT; FOOT PRESENT; .	LATERALLY UNSYMMETRICAL; FOOT BENEATH THE BODY } Gasteropoda, Lamellibranchiata
	{	Molluscoidea.	HEAD AND FEET ABSENT; {	SHELL, DORSAL, AND VENTRAL VALVE. } Brachiopoda.
			LEATHERY, ELASTIC COVERING; SIMPLE OR COMPOUND. }	Tunicata. Polyzoa.

CLASS I. CEPHALOPODA.

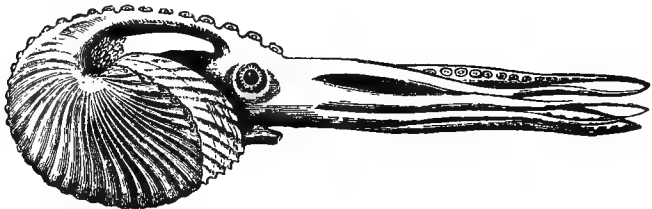
General Characteristics.—The Cephalopods (head-footed) have muscular tentacles or arms around the mouth; beaked, horny jaws; two large eyes: arms covered with sucking discs; and a bag of ink, with which most species blacken the water to hide from pursuit.

		ORDERS.	
CEPHALOPODA.	{	TWO-GILLED.	Dibranchiata, <i>Argonaut, etc.</i>
		FOUR-GILLED.	Tetrabranchiata, <i>Nautilus, etc.</i>

ORDER DIBRANCHIATA.

General Characteristics.—The Dibranchiates (two-gilled), have an ink-gland and the power of changing color like a chameleon.

Fig. 416.

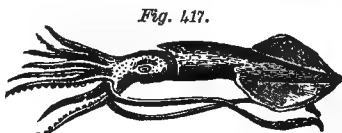


Argonauta argo, Paper Sailor. 1.

The Argonautidæ (sailors) are named from the fabulous

account of their using their delicate shell as a boat, their tentacles as oars, and their expanded mantle as a sail. The female secretes an unchambered shell for transporting her eggs, but is not united to it, though she swims backward with it by enveloping it in her two broad disks and forcing water forward through her breathing funnel. The male has no shell.

The *Loliginidæ* are the "cuttle-fish" of the Atlantic coast. There are many species, some furnishing the thin "pen" and others the thick "cuttle-bone" used for canaries. Some varieties are the "squid" which form the food of the sperm whale.



Loligo bartramii, Squid, Atlantic. 1.

The eight-armed cuttle-fish (*Sepia octopus*) often grows to a length of eight feet, with arms reaching twice that distance. The ten-armed (*S. officinalis*) is common in the Mediterranean Sea. Its ink is a favorite pigment used in water-color painting, under the name of sepia. Its cuttle-bone is a calcareous internal shell occupying a hollow in the back. The *Sepiæ* are flesh-eaters, devouring fishes, crustaceans, and mollusks. In turn they are the prey of the porpoise and dolphin, who eat only the tender head and arms, and reject the rest of the body. The shore of the sea at certain places is covered with these mutilated remains.*

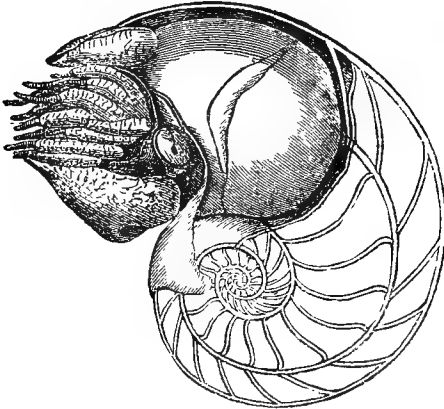
ORDER TETRABRANCHIATA.

General Characteristics.—The Tetrabranchiates (four-gilled) have an external chambered shell, the partitions of which are united by a tube called the "siphuncle." As the

* These monsters of the deep have furnished material for the novelist and the painter. See Victor Hugo's "Toilers of the Sea," and *Harper's Magazine*, vol. xxi, page 185. Their accounts are greatly exaggerated.—Mr. Beale in his *Natural History of the sperm-whale* describes a specimen of the so-called "Rock-squid," not larger than his fist, but with arms expanding four feet. He grasped one of its tentacles, but the cuttle-fish held to the rock with its suckers so strongly as to resist all his strength. A sudden jerk exasperated the animal, which fixed its glaring eyes upon its tormentor and, suddenly releasing its hold, sprang upon his naked

animal increases in size, it partitions off the part previously occupied and moves forward. There are over two thousand fossil species, but only few living.

Fig. 418.



Nautilus pompilius, Pearly Nautilus. $\frac{1}{2}$.
Section showing Chambers and Siphuncle.

The Nautilidæ (sailors) have about a hundred short tapering tentacles, which are quickly withdrawn into the first chamber on an alarm, so that their habits are little known.

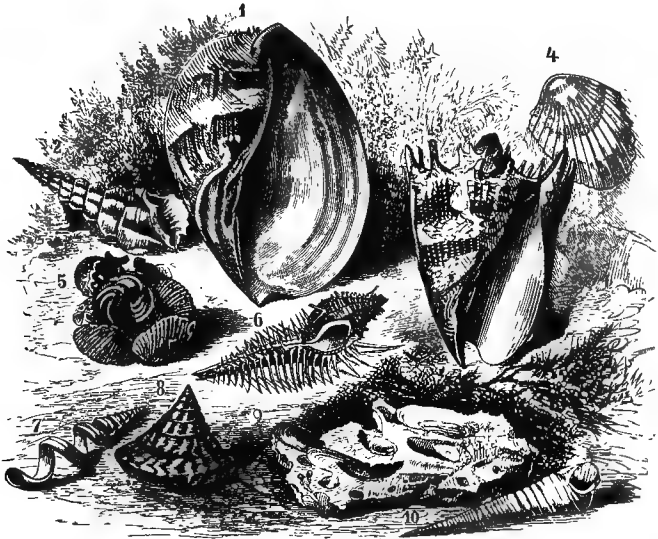
CLASS II. GASTEROPODA.

General Characteristics.—The Gasteropods (belly-footed) move from place to place by a single fleshy disc or foot placed under the abdomen. Most inhabit univalve shells, though some species are naked. The viscera occupy the upper part of the shell, which is secreted by the mantle in various ways, according to the habits of the different forms.

arm and endeavored to reach him with its beak. Its slimy grasp sickened, while its threatening look so alarmed him that he loudly called for assistance. His release was at last effected only by killing the cuttle-fish with the boat-hook, and cutting off its arms bit by bit.

GASTEROPODA.	{	GILLS IN FRONT.	Prosobranchiata,	<i>Murex</i> , etc.
		LUNG-BEARERS.	Pulmonifera,	<i>Snail</i> , etc.
		GILLS BEHIND.	Opisthobranchiata,	<i>Æolis</i> , etc.
		GILLS CLUSTERED.	Nucleobranchiata,	<i>Carinaria</i> , etc.
		WING-FOOTED.	Pteropoda,	<i>Clio</i> , etc.

Fig. 419.



SHELLS OF GASTEROPODS USED FOR ORNAMENTS.—1. *Cyrdium broderipii*; 2. *Cerithium*; 3. *Voluta imperialis*; 4. *Cardium elatum*; 5. *Phorus agglutinans*; 6. *Murex tenuispinus*; 7. *Vermatus eburneus*; 8. *Trochus niloticus*; 9. *Lithodæmus lithophagus*; 10. *Turritella*.

ORDER PROSOBRANCHIATA.

General Characteristics.—The Prosobranchs (gills forward) have the gills placed in front of the heart.

Muricidæ (rock-shells).—The *Murex* has the aperture of its shell prolonged into a canal.* It is carnivorous, destroy-

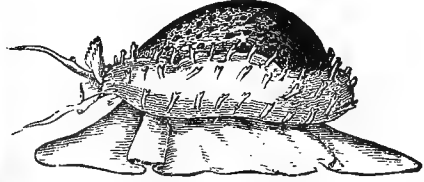
* The Shetlanders use this shell for a lamp, inserting the wick in the canal and filling the body of the shell with oil.—From these Mollusks the ancients obtained the costly Syrian dye, the "purple" of Scripture.

ing its prey with its terrible armature (*odontophora*) or tooth-ribbon, analogous to the band of a chain saw, and set with adamantine teeth, sharp-edged, and pointed as those of a shark.

Fig. 420.

Teeth of *Murex*.

Fig. 421.

*Cypræa tigris*. $\frac{1}{2}$.

The *Cypræidæ* (Cowries) have the mantle, in many species, covered with filaments and the foot enormously developed. The eyes are near the base of the tentacles, and the tooth-ribbon is armed with a series of powerful teeth.

The *Harpidæ* (harp-shells) are found on the shores of the Mauritius, and are remarkable for having too large a foot wholly to conceal within the shell.

The *Haliotidæ* (sea-ears) have shells of a pearly lustre, with resplendent metallic hues, useful for inlaying the darker woods and for sleeve-links.

Fig. 422.

*Fissurella listeri*.

The *Fissurelidæ* (fissured) have an aperture in the top, and, adhering to the rocks, seem adapted to a sedentary life.

The *Dentalidæ* (toothed) have a shell shaped like a miniature elephant's tusk. At the base of the conical foot is situated the head.

Fig. 423.

*Dentalium dentalis*.

ORDER PULMONIFERA.

General Characteristics.—The Pulmonifers (lung-bearers) are air-breathing, even those inhabiting the water being obliged to come frequently to the surface. They have

Fig. 124.



Helicidae, Land Snails.

the simplest form of lung—a mere cavity, with an orifice at the right side of the neck which the animal can open or close at will. They are herbivorous, and often very destructive to grain fields and fruit trees.

Fig. 125.



Limax antiquorum, Great Gray Slug, Europe.

Helicidæ (spiral-form).—The *Land-snail* has four tentacles, the longer pair with eyes at the extremity. It lays its eggs singly, while the other Orders lay theirs in chains.*

Limacidæ.—The *Slugs* are snails without the shell, or with only a rudimentary one concealed in the mantle.

ORDER OPISTHOBANCHIATA.

General Characteristics.—The Opisthobranchs (gills behind) are generally naked, with feathery gills behind the heart.

Fig. 426.



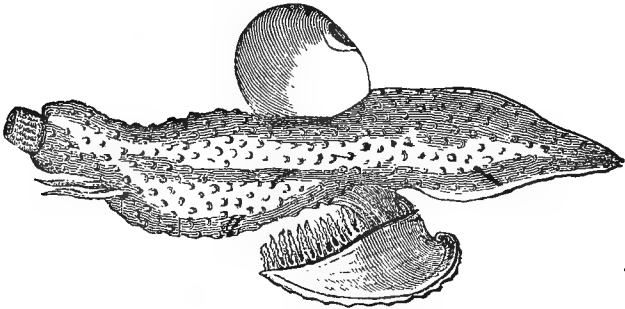
Æolis, Britain.

The *Æolis* is typical of the order, having its gills arranged in tufts along the back, and the tentacles non-retractile.

ORDER NUCLEOBANCHIATA.

General Characteristics.—The Nucleobranchs (clus-

Fig. 427.



Carinaria mediterranea.

* If placed upon a pane of glass, by looking underneath, one can easily observe its curious progression by means of a single foot.

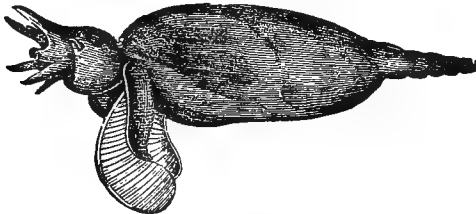
ter-gilled) have their respiratory organs in a nucleus, and their foot modified into a sort of fin for swimming.

The *Carinaridæ* (keeled) have the more delicate organs protected by a small shell fringed around the mouth with gills, while the larger part of the animal is exposed. The fin-like foot has a small sucker for attaching to sea-weed, compelling them to swim with the back downward.

ORDER PTEROPODA.

General Characteristics.—The Pteropods (wing-footed) move by means of two wing-like fins. The animals are small, yet occur in such numbers as often to color the ocean for miles. They are probably carnivorous, and, in turn, are food for the whale.

Fig. 428.

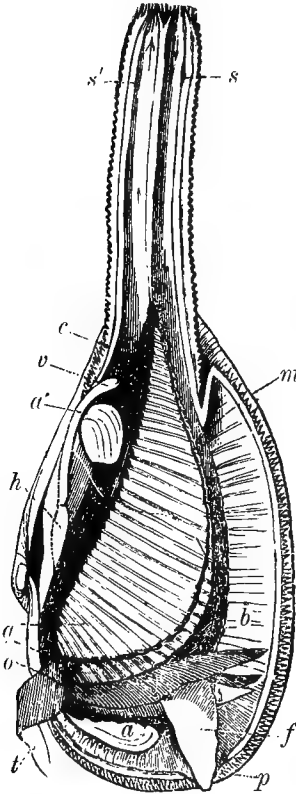


Clio borealis.

Cliidæ.—The *Clio* is only an inch long, but its prehensile apparatus is elaborate. Six labial tentacles bear about three hundred and sixty thousand suckers for seizing and holding its minute prey, which is speedily reduced by the laterally-working jaws full of long, comb-like teeth, and by the tongue rough with sharp, spiny, recurved hooklets.

CLASS III. LAMELLIBRANCHIATA.

Fig. 129.

*Mya arenaria*, Clam. †

General Characteristics.—The Lamellibranchs* (lamellated gills) are all bivalves. The two parts of the shell are connected by a hinge, usually with interlocking teeth. To hold them open—that being always the unconstrained position—an elastic ligament is fixed to the hinge, if inside, acting by expansion, if outside, by contraction. The valves are closed by muscles, ordinarily two, but sometimes only one. The respiratory organs are leaf-like gills, to which in the lower forms the water is brought by a double tube, one orifice for ingress, and the other for egress, after it has laved the gills and circulated around the mouth which filters out the food. Most move by means of a foot, which is often very powerful, and, in the boring species, is covered with flinty particles.

LAMELLI- BRANCHIATA.	{ SIPHONS PRESENT. }	Siphonata. {	Clam,
			etc.
	{ SIPHONS ABSENT. }	Asiphonata. {	Oyster,
			etc.

* All this class are headless, and hence they are sometimes termed "Acephala." They are also called Conchifers (shell-bearers).

† All the viscera, right valve and half the siphon retained. g. Gills; s. Siphon introducing water to the gills and mouth; s'. Siphon carrying out the water after it has bathed the gills and surrendered the food which it contained to the mouth, o; t. Four lip tentacles; h. Heart, the intestine v passing through it; m. Mantle ligament uniting the valves around their edges; p. Orifice in the mantle through which the foot f protrudes; c. Cloaca; a, a'. Muscles closing the valves by their contraction.

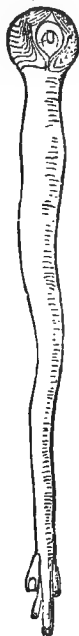
ORDER SIPHONATA.

General Characteristics.—The Siphonata (siphoned) include those lamellibranchiates which have respiratory tubes distinctly separated from each other, and the lobes of the mantle more or less united.



Solen ensis, Razor Shell.

Fig. 431.



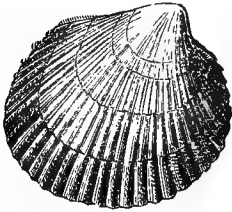
Teredo navalis, Ship-worm.

Solenidæ (channeled) have a shell shaped like a razor-handle, with a large foot, that can be turned into an awl for boring into the mud, and then into a ball for pushing themselves to the surface.

The **Cardiidæ** (heart-shaped) put forth a foot capable of distention with water introduced through an orifice near the mouth. By a rotary movement of the foot thus thick-

ened, they excavate a burrow sufficiently large to receive the entire shell.

Fig. 432.



One-half of a Cockle Shell, showing lines of growth.

The *Teredinidæ* (borers) have on their anterior part a pair of valves which they use to bore into wood. They line the cavity, as they proceed, with shelly matter, often making a tube two feet in length. They work in various directions, but never encroach upon one another, though it is difficult to comprehend how they be-

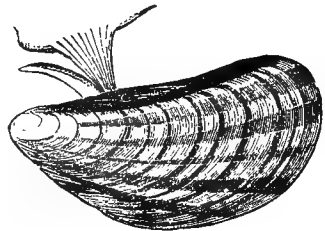
come aware of the proximity of their neighbors.

ORDER ASIPHONATA.

General Characteristics.—The *Asiphonata* (siphonless) include all bivalves with open mantle and without a siphon.

The *Mytilidæ* (mussel-fish) anchor their shells to rocks by means of gluey threads, that seem either to grow or be spun from the foot. This “byssus” is in some species so long and silken, as, for a curiosity, to be woven into cloth.

Fig. 433.



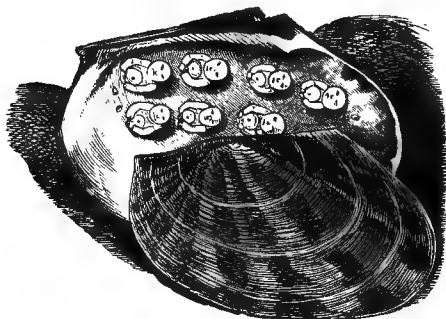
Mytilus edulis, with byssus.

Ostræidæ.—The *Common Oyster*, found along the Atlantic coast, when young, is free, but soon attaches itself to rocks by the left or rounded valve.

It thus generally lies on its left side. By ciliary movements, it produces currents which convey the water through the open mantle to the gills for respiration, and then hurry it on to the mouth, which lies back, near the hinge, where the labial fingers extract the food it may contain.*

* The hard part always cut in opening the shell is the adductor muscle whose business is to shut the valves. These open naturally about one-half of an inch. The mantles on the two sides of the shell meet at the aperture. Their edges are fringed with cilia—the English call them the oyster's beard—which can be protruded from

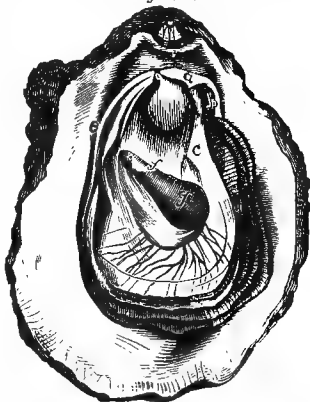
Fig. 134.

*Meleagrina margaritifera*, with lead images covered with pearl nacre.

The **Aviculidæ** (little-bird) include the pearl-makers. These gems are caused by the effort of the animal

the shell and used in bringing inside animalcules and the spores of algæ for food. The lime for building the shell is secreted by the mantle. The plaited frills on the mantle are the gills. The heart, shaped like an old-fashioned purse, has an auricle and ventricle, and circulates a limpid colorless blood. If the shell be opened with care, the beating of this organ may be distinctly seen. The black liver is large and secretes a deep yellow bile in large quantity. The mouth is provided with tentacles by which food is selected and carried inside. The oyster wants brains and eyes, and has no sense except that of touch, which is located in the tentacles. The eggs are yellowish, and a single oyster may contain two millions, lying in the folds of the mantle and looking like thick cream. When the proper time arrives they are ejected into the water in a milky cloud. Each little oyster, though not larger than the point of a pin—a whole troop being able to swim freely about in a drop of water—has a perfect shell, and is provided with a fleshy pad for attaching itself to any object at hand. Crustaceans, worms and enemies of all kinds, with a natural liking for raw oysters, flock in to the feast, and a few score only of the millions escape. The survivors anchor themselves to some rough surface and grow rapidly. In a month they will be as large as a pea. If we examine a shell we can see the layers overlapping each

Fig. 135.

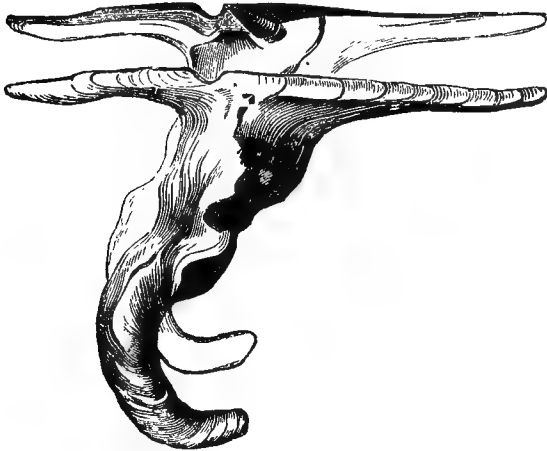


Ostræa edulis, Common Oyster, in shell, upper valve removed. a. Upper portion of mantle covering the mouth with its four lips; b, c. The mantle; d. The breathing organs; e. Portion of the lobes of the mantle, between which is the extremity of the intestinal canal; f. Part of the heart; g. Adductor muscle.

to cover up with nacre any irritating substance, as a grain of sand, that may have gotten beneath the mantle.*

The *Hammer Oyster* of the Indian Ocean presents one of those singular forms seemingly designed to puzzle natural-

Fig. 436.



Mallus vulgaris, Hammer-oyster.

ists in endeavoring to account for the utility of the anomalous appendages.

other like shingles, each one indicating a season's growth and the series showing the oyster's age. In three or four years a marketable size will be reached. The little red crab often found sharing the oyster's home is the *Pinnotheres ostræum*. The female is generally seen, as the male is scarce. The latter has its back ornamented with a white figure very like an anchor.—At the discovery of America the oyster was abundant upon the Atlantic coast. Immense mounds of shells lie along the shore, from Maine to Florida. They antedate the time of the Indian, and are so large that in Florida, during the late war, some were used as forts. See Lockwood's "Natural History of an Oyster," in *Popular Science Monthly*, November, 1875.

* Taking advantage of this, the Chinese have long been in the habit of producing pearls artificially by slipping metal images under the mantle and then releasing the animals. In six months the figures are found overlaid with a pearly secretion. Sometimes, however, the crafty Celestials paste these images upon the interior of a dead shell and then paint it over with a mixture of powdered "mother of pearl," in exact imitation of the genuine.

CLASS IV. BRACHIOPODA.*

General Characteristics.—The Brachiopods (arm-footed) have the valves on the upper and the under side of the body, instead of the lateral; are without a hinge ligament, the valves opening and shutting by a complicated arrangement of muscles; respire by blood-vessels ramifying minutely over the surface of the mantle; and obtain their food, in most species, by two long spiral arms, capable of being unrolled and extended to a great distance.

Fig. 438.



Terebratulina septentrionalis,
Lamp-shell.

The **Terebratulidæ** (boring family) have the back of the ventral valve pierced with a hole for the passage of the pedicle, by which the animal is permanently attached to solid substances.

The **Lingulidæ** (tongue-shape) have a long pedicle issuing from the interior of the shell through the hinge.

Fig. 437.



Dorsal valve of a
Brachiopod, with
one spiral arm
partly uncoiled.

Fig. 439.



Lingula anatina.

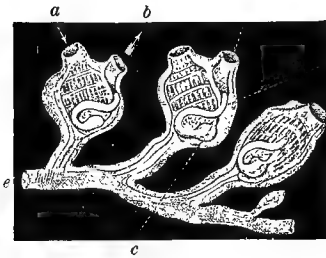
CLASS V. TUNICATA.

General Characteristics.—The Tunicata (cloaked) have no shell, head, feet, or arms, and usually look like shapeless gelatinous masses, composed of two tunics or coatings, forming a tube, with one orifice for the inlet and

* Prof. E. S. Morse, endorsed by some other Naturalists, classes the Brachiopods with the Annelids.

another for the exit of water. They have a stomach, pulsating heart, branchial appendages, and highly developed secretory organs. Some are simple, others attached to a common mantle, but each individual maintains a separate existence.

Fig. 440.



Clavellina lepidiformis, Social Tunicates or Ascidians. a. Incurrent orifice; b. Excurrent do.; c. Stomach; d. Intestinal canal; e. Common stem.

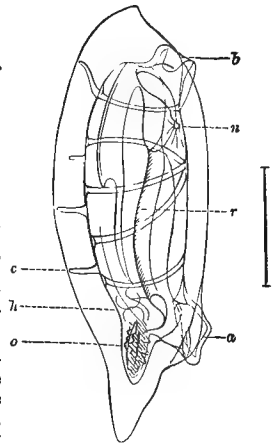
the heart gives the opposite impulse, and the blood travels the other way, through the same vessels.

The *Salpidæ* (stocked) are so transparent that the structure of their internal organs may be examined through their coatings. They present an example of alternate generation. An individual *Salp* resembles "its grandparent, its grandchildren, and its own brethren," but differs equally from its parent and its own children. A single egg

a maintains a separate existence.

Clavellinidæ (little knobs).—These *Ascidians* are united by a common stem.* The elongated heart contracts from behind forward, so as to propel the blood in one direction, and after a few moments, the pulsations becoming fainter and fainter,

Fig. 441.



* The history of a cluster is as follows: A single individual just from the egg possesses active powers of locomotion. After wandering a time it attaches itself, and sends forth creeping stems, from which, at brief intervals, there bud and grow to maturity other individuals. From each of these proceed young, to become in like manner the parents of other colonies. This free motion of the immature *Ascidians* provides for the general diffusion of these animals, and prevents their being crowded in particular spots.

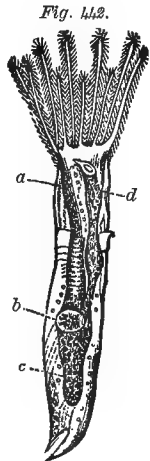
Salpa cabotti. a. Posterior orifice; b. Anterior do.; c. Processes by which the individuals of the chain were united; h. Heart; n. Nervous ganglion; o. Nucleus; r. Gill.

gives birth to an individual which, by budding, produces long chains of aggregated individuals* greatly different from the parent. Each of these produces an egg, which hatches an individual like the grandparent. Thus the series is repeated endlessly.

CLASS VI. POLYZOA.

General Characteristics.—The Polyzoans (many-animals), or Bryozoans (moss-animals), are compound; each individual, however, inhabiting a separate cell or tube. The mouth is surrounded with ciliated tentacles, and the whole animal can usually be entirely withdrawn into the cell, which is in some species soft and flexible, in others horny, and in others calcareous. In the genus *Bowerbankia*, the structure is so delicate and transparent that the interior may be clearly seen. The Bryozoan is thus perceived to have a complex digestive apparatus floating freely in the general cavity—a gizzard for triturating the food, a liver for secreting bile, an intestinal tube, and a distinct excretory orifice outside the circle of tentacles.

The **Flustræ**, or “Sea-mats,” are Bryozoan communities, consisting of a multitude of horny, calcareous cells, some species incrusting stones, others spread out like a thin network of gauze, each cell containing an individual polyzoan. The whole progeny of a single isolated specimen of sea-mat spring, by budding, from an embryo produced in each egg, within which two little Bryozoa are found. These make their



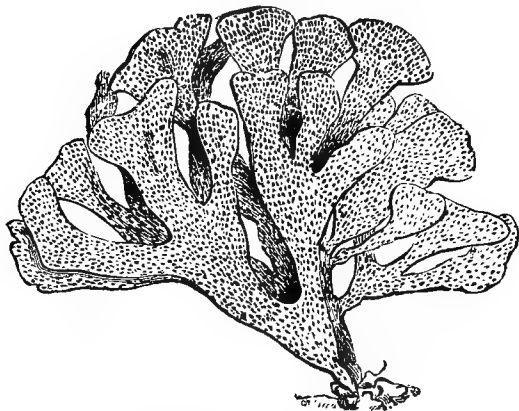
Bowerbankia.

- a. *Esophagus* ;
- b. *Gizzard* ;
- c. *Stomach* ;
- d. *Excretory orifice.*

* The progeny of a single egg unite by the adhesion of their surfaces, or of little suckers, so as to string out as far as the eye can reach. Being phosphorescent in the night, these long-drawn bands give the effect of ribbons of fire, twisting and doubling as they rise and fall with the waves.

escape, and, after swimming about for a time, attach themselves, and the pairs lay the foundation of a new colony.

Fig. 443.



Flustra foliacea, Sea Mat.

Some genera of Polyzoans possess singular processes resembling a bird's beak, each cell having one and sometimes two. These open and shut constantly, and if they are touched with a needle, the mandibles will snap together upon it so forcibly that the whole branch may be shaken by it.

IV. SUBKINGDOM ECHINODERMATA.

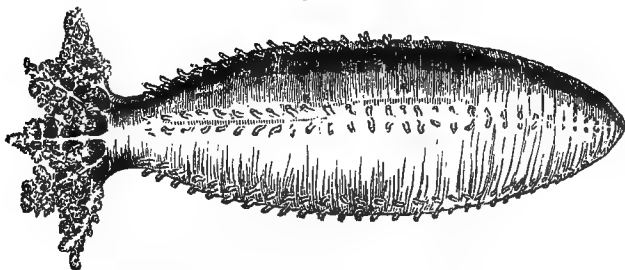
General Characteristics.—The Echinoderms (spiny-skinned) have all the parts symmetrically arranged around a central axis, thus necessitating a peculiar system of radiating canals and nervous ganglia. They are all oviparous. They respire by a water-vascular system permeating the entire body. There is also a blood vascular system, with a central contractile heart.

ECHINODERMATA.	{	BODY CYLINDRICAL ; FREE ; MOUTH FORWARD.	Holothuroidea.
		BODY SPHERICAL OR FLAT ; FREE ; MOUTH UNDERNEATH.	Echinoidea.
		BODY STAR-SHAPED ; FREE ; MOUTH UNDERNEATH.	Asteroidea.
		BODY CUP-SHAPED ; FIXED ; MOUTH UPPERMOST.	Crinoidea.

CLASS I. HOLOTHUROIDEA.

General Characteristics.—The Holothuroids (whole-mouthed) have a tough skin, sprinkled with calcareous granules. The mouth is surrounded with feathery tentacles,

Fig. 444.



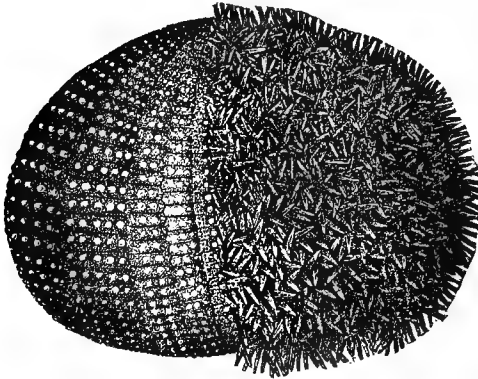
Pentacta frondosa, Holothuroid or Sea-cucumber.

and the body is worm-shaped, though constructed upon the radiate plan. By means of their powerful longitudinal and transverse muscles, they can disgorge their own stomachs, and even throw off their tentacles, and, after remaining inert for a season, take on a new set of the rejected organs.

CLASS II. ECHINOIDEA.

General Characteristics.—The Echinoids (hedgehog-like) are covered with spines, moved by the general enveloping membrane.

Fig. 445.

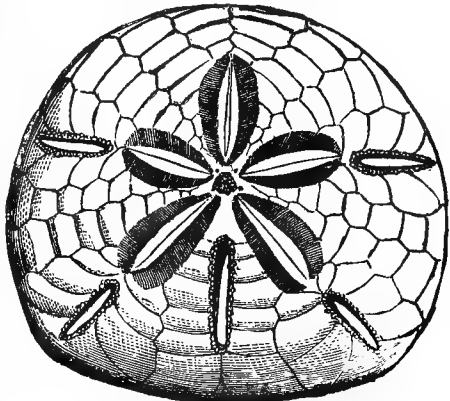


Echinus sphaera, Sea Urchin. Spines removed from left half.

Their shell is composed of regularly-shaped plates, arranged in radiating zones, every alternate plate perforated for the passage of suckers (*ambulācra*), which can be extended beyond the spines,* and by adhesion enable the animal

to move over the rocks. Mingled with the spines are stems (*pedicellariæ*), each ending in forceps, apparently for prehension and for ridding the animal of parasites. The mouth is armed with five sharp teeth, which continually wear upon one another, but,

Fig. 446.



Melitta quinquefōra, Key-hole Urchin.

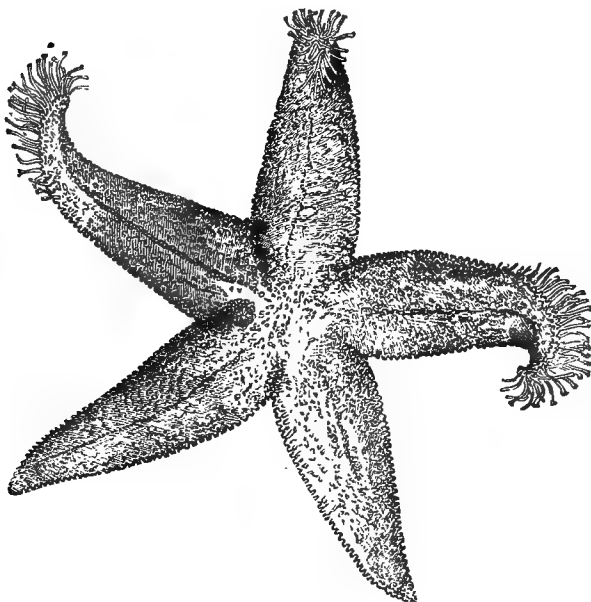
* A full-grown Urchin may have five hundred plates, four thousand spines, and perhaps two thousand suckers.

like the incisors of a rodent, are constantly renewed. These are worked by thirty-five powerful muscles—the whole apparatus being known as “Aristotle’s lantern.”*

CLASS III. ASTEROIDEA.

General Characteristics.—The Asteroids (star-like) have five or more radiating arms, which contain portions

Fig. 447.



Asterias, Star-fish.

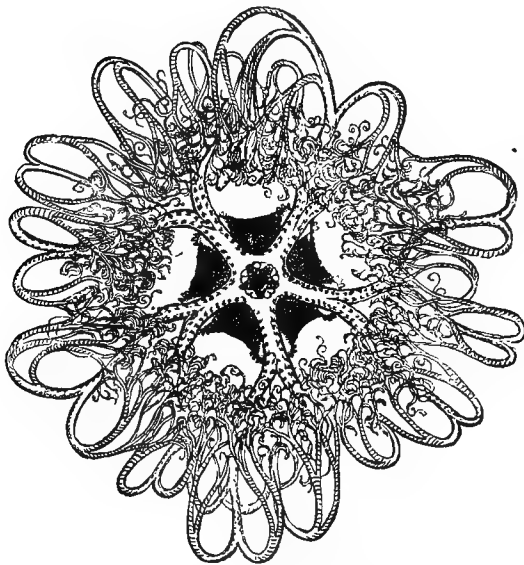
of the viscera. Their mouth and locomotive suckers are on the lower side—the former without teeth, digestion being performed by the animal’s turning its stomach out of its

* Some species, like the Key-hole Urchin, are singularly modified from the typical forms, and are hence called Irregular Echinoids.

mouth and wrapping it over the shell-fish, etc., upon which it feeds. On the end of each ray is a red eye, over which a circle of spines may be thrown for its protection.

The *Star-fish* can adapt itself to the inequalities of the surface over which it moves, and even enter narrow fissures.

Fig. 448.



Astrophyton agassizii, Basket-fish.

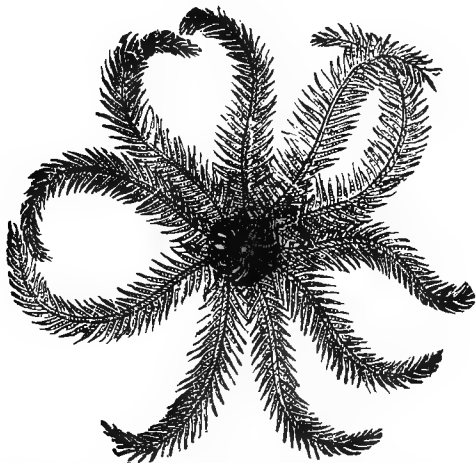
On the back is a kind of sieve (madreporic body), through which water filtered of sand passes to the locomotive suckers. In some species, the five arms are subdivided till the number of branches is nearly five thousand.*

* All the Star-fishes, of which there are at least one hundred and fifty species, have the power of disintegrating themselves, especially the many-branched varieties, and of restoring in a brief time the portions broken off. Hence when fishermen vent their spite upon them for stealing their bait, by tearing them in pieces and throwing them overboard, they simply multiply the evil. Immersed in fresh cold water they die instantly.

CLASS IV. CRINOIDEA.

General Characteristics.—The Crinoids (lily-form) are Echinoderms that during a portion or the whole of their lives are fixed to some solid body by a foot-stalk (peduncle). They strikingly resemble a flower. The mouth is in the

Fig. 449.



Comatula rosacea, Rosy Feather-star. Adult free Crinoid.

centre, with arms springing from the disk or calyx, but speedily ramifying until the complete internal skeleton, exclusive of the stem, consists of many thousand joints. All parts are covered with a fleshy integument, dipping down between each joint. Some of the species remain fixed for life, while one at least (*Comatula*) is known at maturity to drop from the stem and ever after to wander free. (See "Geology," pp. 129, 153, 171.)

Fig. 150.



Pentacrinus asteria, Living Crinoid, West Indies.

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V.

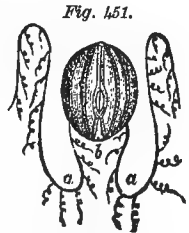
SUBKINGDOM CŒLENTERATA.

General Characteristics.—The Cœlenterates (hollow-entrained) are radiates having a distinct body-cavity, whose walls consist of an outer layer (*ectoderm*) and an inner layer (*endoderm*). They are all aquatic, and multiply alike by budding, by eggs and by fission. They are usually armed with peculiar stinging filaments.

CŒLENTERATA.	}	DIGESTIVE CAVITY, WITH TWO OPENINGS.	Ctenophora.
		DIGESTIVE CAVITY, DOUBLE, WITH RADIATING SPACES.	Anthozoa.
		DIGESTIVE CAVITY, SINGLE.	Hydrozoa.

CLASS I. CTENOPHORA.

General Characteristics.—The Ctenophora (comb-bearers) are transparent, gelatinous bodies, with eight rows of comb-like fringes and two long tentacles provided with lateral filaments spirally coiled. The latter can be instantly withdrawn into the cavities from which they spring, and as quickly shot forth again. The Ctenophora have a nervous system and complex digestive apparatus.



Pleurobrachia pileus,
A Ctenophore.
a, a. Tentacula ;
b. Mouth.

CLASS II. ANTHOZOA.

General Characteristics.—The Anthozoans (flower-like animals) or Polyps (many-footed) comprise the Cœlenterates in which a distinct digestive sac opens below into the general cavity of the body, though separated from the body-walls by an intervening space. The mouth is surrounded by one or more rows of hollow tentacles, which are covered with cilia in constant motion, to produce currents for bringing food

The *Sea-fan* is another representative form of sclerobasic coral, the branches having a horny axis (as may be detected by the smell in burning), and uniting in a beautiful net-work.

The *Madrepores* and other reef-forming corals deposit within the tissues of the animal a calcareous frame-work of *sclerodermic* coral.

Fig. 457.

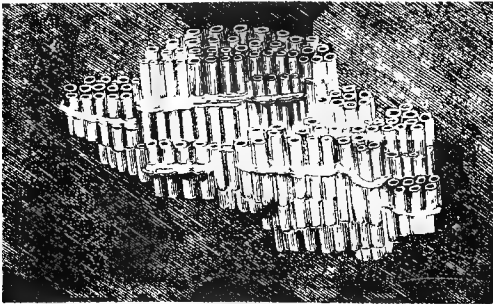
*Otenactis echinata*, Mushroom Coral.

The *Mushroom Coral* is remarkable as being the skeleton of a single Polyp, often fifteen inches in diameter. Though fixed in its early stages, it becomes free,

and, but for its habit of lying in the clefts of the rocks, would be speedily destroyed by the violence of the waves.

The *Organ-pipe Coral* consists of cylindrical tubes arranged like the pipes in a church organ. Each one is the cell of a single polyp, and the whole number in the mass is the progeny of the one that first became fixed at the base.

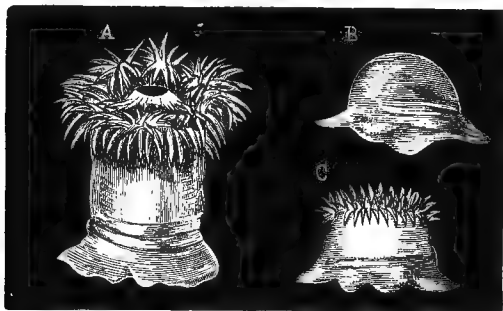
Fig. 458.

*Tubipora musica*, Organ-pipe Coral.

* Dana, in describing the coral reefs of the Pacific, says—The actinæ (Fig. 459) may well be called the asters, carnations and anemones of the submarine garden; the tubipores (Fig. 458) are literally its pink beds; the gorgoniæ (Fig. 456) its flowering twigs; the madreporæ (Fig. 455) its plants and shrubbery. Astræas (star corals) often form domes amid the grove, a dozen feet or more in diameter, embellished with green or purple blossoms, which stud the surface like gems; hemispheres of meandrina (brain coral) appear as if enveloped in a network of flowering vines; and vases of madreporæ stand on a cylindrical base covered with branches spreading gracefully from the center and decked with sprigs of tinted polyps.

The *Sea Anemone* is a soft-bodied Polyp, that can change its locality at will, adhering to the rock by a fleshy disk that adapts itself to all inequalities. Its stomach is simply a sac suspended in the cavity of the body, into which it opens at the bottom by a wide aperture. Between the stomach and

Fig. 459.



Metridium marginatum, Sea-anemone or Actinia.
A. Opened; B. Closed; C. Opening.

the body-walls are mesenteric spaces, which communicate freely with the numerous hollow tentacles. By muscular contraction, water is forced from these chambers into the tentacles, to prolong them. The animal, plastered, as it were, to a rock, with its tentacles bloomed out like the rays of its flowery namesake, awaits its prey; and woe to the luckless victim that walks over the trap and springs it into activity. (See Fig. 393.)

CLASS III. HYDROZOA.

General Characteristics.—The Hydrozoa (water-dragon animals), or Jelly-fishes,* have no mesenteric spaces, and the eggs are developed on the external instead of the internal

* On account of the stinging sensation produced when handled, the animals belonging to this class have been called *Acalephæ* (Nettles); *Medusæ* from the numerous tentacles resembling the hair of *Medusa*; and *Jelly-fishes* from the gelatinous nature of their substance.

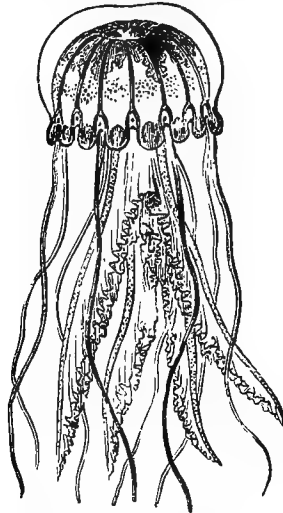
Fig. 460.



Lasso.

surface of the body-wall. Interspersing the tentacles and other parts of the body are cells containing long, spirally-coiled threads, barbed and serrated, which dart forth with inconceivable velocity to lasso their prey.*

Fig. 461.

*Pelagia cyanella*, Jelly-fish.

The **Discophoræ** (disc-bearers) include those Jelly-fishes with an umbrella-like disc, by the contraction of which the water is expelled and swimming effected. Some of this family measure seven feet in diameter, with tentacles a hundred feet in

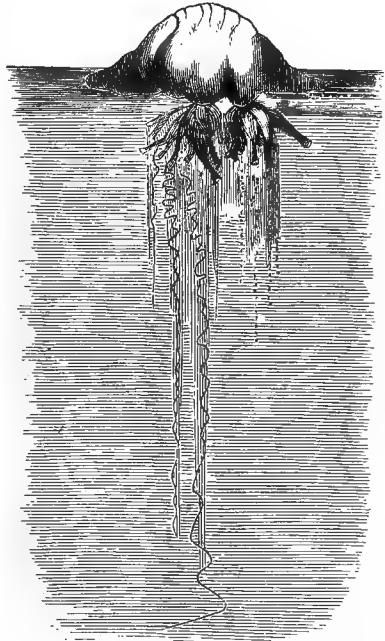
* They are the terror of bathers, as the pain inflicted by the lash of their envenomed filaments is exceedingly deranging to the whole nervous system, though at first seeming to be no more than the tingling sensation of the common stinging nettle.

length; yet so largely composed of water that, when dried, nothing is left but a film scarcely sufficient to stain a sheet of white paper. They are voracious, feeding on small fishes, crustaceans, and even on their own species. Mere transparent masses of jelly, and only visible because of their brilliant colors, they move through the water rapidly, and lasso their prey with great precision.

The *Siphonophoræ* (tube-bearers) are free swimmers and characterized by having one or more large air-sacs, giving great buoyancy.

The *Hydroidæ* (hydra-form) include the compound Sertularians (see Fig. 393) and the simple Hydras. The former resemble minute ferns, and are often mistaken for sea-weed. Some species of *Hydræ* are found in fresh water, attached to the stems of plants. When contracted, they are a little mass of green jelly. Expanded, their body is a tube, half an inch long, not larger than sewing-thread.* By the sucker at the base

Fig. 462.



Physalia utriculus, Portuguese Man-of-war,
Tropical Atlantic.

* It may even be turned inside out like a glove—what was the outer surface becoming a stomach and beginning to digest the food, and what was the intestinal canal taking up the functions of absorption and respiration. Sever a Hydra's stomach, and the mouth will still keep taking in food, though there is nothing to hold it until the digestive organ grows again. "The same Polyp may be successively inverted, cut in sections, and turned back again without serious harm."

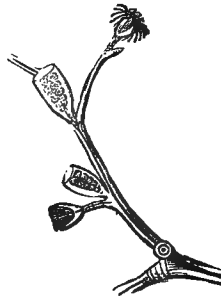
they attach themselves at will to any solid object. Their mouth is surrounded by hollow tentacles, by which they seize their food, and quickly benumb it. Cut into pieces, each part quickly grows into a perfect animal.

Fig. 163.



Fresh water Hydras. 1. Stem of plant; 2. Hydra attached and budding; 3. Partly expanded; 4. Fully expanded; 5. Free and progressing.

Fig. 164.



Campanularia volubilis.

Medusoids. After leading an independent and locomotive existence for a time, these produce ova and sperm-cells, the resulting embryos of which fix themselves and develop into plant-like colonies, from which fresh medusoids may bud. The Medusoid little resembles the plant-like Zoöphyte from which it thus springs. It sails through the water by the contraction of its bell, the tentacles hanging like a fringe below, and the four radiating canals leading to its central stomach.

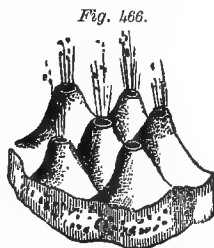
Fig. 165.



Medusoid.

CLASS IV. SPONGIDA.

The **Sponge** of commerce is the frame-work which, in the living animal, is covered with a slimy material resembling the white of an egg, but so delicate that it is usually washed off by merely drawing the mass from the water. This investing sponge-flesh consists of numerous minute nuclei acting independently of one another, and yet individually contributing to the sustenance of the whole colony. Canals permeate this gelatinous substance in every direction. The smaller ones permit the ingress of water



Living Sponge magnified.

to take the place of that constantly rushing out by the larger orifices. These currents are due to the action of cilia in enlarged portions of the canals, and thus food is diffused throughout the mass. The cells along the route select and appropriate the nutritive particles. The Common Sponge (*Euspongia officinalis*) is not a single sponge but a community, "representing," as Huxley remarks, "a kind of sub-aqueous city, where the people are arranged about the streets and roads in such a way that each can choose his food from the water as it passes along." The skeleton is composed of horny fibres interlacing and strengthened with spicules of lime or flint. The frame-work in some species is calcareous or silicious. In the *Euplectella* the silicious fibres form a beautiful mesh of lace, known as Venus's Flower Basket, formerly considered an unique specimen of Chinese industry.

VI. SUBKINGDOM PROTOZOA.

General Characteristics.—The Protozoans (first animals) are small, aquatic, mostly microscopic unicellular animals. They are composed of a mucous, albuminous substance called *protoplasm*. As yet, neither nerves, muscles, circulatory or digestory organs have been discovered. They, however, apparently possess the functions of animal life—motion, sensation, nutrition, and reproduction. Innumerable Invertebrates feed upon them. The “Edible-earths” and “Infusorial-earths” probably owe their nutritive value to the remains of Protozoans. All subdivisions are provisional.

CLASS INFUSORIA.

General Characteristics.—The Infusoria (originating in infusions) include a large variety of microscopic animalcules found in vegetable infusions that have been left exposed to the air for a few days. Their presence is doubtless due to the dried bodies of their ancestors or minute germs floating in the air till a lodgment in the infusion favors development.*



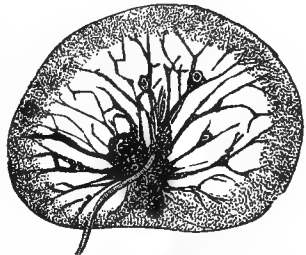
Vorticels (vortex) are types of fixed forms. To the naked eye they are simply mold on the stem of a plant; but in the microscope the mold becomes a forest of single animalcules, each attached by a stem several times its own length,

* Re-moistening the hard, baked mud from the bottom of a dried-up pool is found to re-vivify them in innumerable quantities. “These Infusoria,” says Fignier, “may be and are without doubt carried to great distances, for an indefinite period of time, and then, abandoned on some ledge of rock, on a housetop, in the cleft of a wall, or

and capable of being contracted into a spiral form. The ciliated fringe can also be retracted within the body. They multiply by *fission*, *budding*, and *encysting*. If by fission, the body simply splits into two portions, each becoming a new being.* If by budding, a swelling commences near the base of the bell, which at length detaches itself, and developing a stalk, becomes fixed. If by encysting, a coating of gelatinous matter covers the bell, the stem and cilia being absorbed. In time, the cyst bursting, a number of germs are set free, which develop stalks and become like the original. It has been calculated that the progeny of a single individual of some species of Infusoria may amount to two hundred million in a month.

The *Noctiluca* are examples of free forms, in which locomotion is effected by thread-like organs called *flagella*. The phosphorescent glow upon the sea is largely due to their presence.

Fig. 468.

*Noctiluca mitis*, magnified.

CLASS RHIZOPODA.

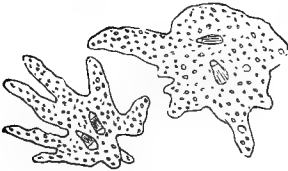
General Characteristics.—The Rhizopods (root-footed) are minute masses of gelatinous matter capable of assuming all varieties of shape according to the irritation result-

under the capital of a column, lie there undisturbed; but let a drop of water approach it, and the dormant being awakes immediately, the microscopic Lazarus springs again into existence, feeds and multiplies as before, and its life, suspended possibly for years, resumes its interrupted course!"

* "By this mode of propagation," says Dujardin, "an Infusorian is the half of the one which preceded it, the fourth of the parent of that, the eighth of its grandparent, and so on, if indeed we can apply the terms father or mother to an animal, which must see in its two halves the grandfather himself, by a new division again, living in his four parts. We might imagine such an Infusorian to be an aliquot part of one like it, which had lived years, and even ages before, and which by continued subdivisions into pairs might continue to live forever by its successive development."

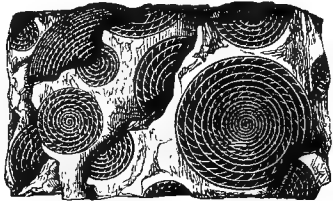
ing from contact with foreign substances. Some species are naked, while others are protected by a shell. When particles

Fig. 469.



Amœba radiosa, Rhizopod.

Fig. 470.



Nummulites atatica, Rhizopod.

of food are wafted into contact with this gelatinous mass, finger-like processes—in some species filamentous, in others blunted—shoot out and wrap up the nutritive particles, so completely enveloping them as to appear like a thin

Fig. 471.



Foraminifera in Chalk.

film over the enclosed mass. The food is gradually absorbed by the coating of this extemporized stomach. The processes thus shot forth and answering as hands or feet are termed *pseudopodia* (false feet). In those species protected by a shell there is the same power of throwing out pseudopodia at the orifice for locomotion or prehension, and in the latter case, of transposing the prehensile instrument into a mouth or alimentary canal. Reproduction is by fission, budding and cysting, a detached pseudopodium being developed sometimes into a separate animal. When, by budding, the new Rhizopod remains attached to the shell of the parent, in some species, particularly the Foraminifera (hole-bearing),* it gives rise to the beautiful aggregated forms known as Nummulites, Globigerinas, etc.

CLASS GREGARINIDA.

General Characteristics.—The Gregarinidans (flocks) are parasitic forms found particularly in Cockroaches and Earth-worms. They give out no pseudopodia, and assimilate food only by the absorption on the general surface, as is common in internal parasites. Their anatomical structure usually presents a single cell, having in it, among fatty granules, a central vesicle, itself enclosing a solid particle. Elongation and contraction of the body are the ordinary signs of life.



Fig. 472.

Gregarina sipunculii,
greatly magnified.

Still lower forms, however, are revealed by the microscope, as the Monera, comprising the genera *Bathybius*, *Protamoeba*, etc., by some Naturalists disbelieved in as really organic beings, and by others doubtfully referred to the Vegetable rather than to the Animal Kingdom. Of these *Bathybius*,† a mass of albuminous jelly neither distinctively animal nor plant, is considered the simplest structure known to man.

Fig. 473.

*Bathybius*.

* See "Fourteen Weeks in Geology," pp. 188 and 198.

† Recently Huxley retracts his opinion concerning *Bathybius* as having vitality.

SYSTEMATIC ARRANGEMENT

OF THE

REPRESENTATIVE FORMS USED IN THIS WORK.

ANIMAL KINGDOM.

SUBKINGDOM.	CLASS.	ORDER.	FAMILY.	GENUS. SPECIES.	EXAMPLES.
MAMMALIA.	QUADRUMANA.	BIMANA.	HOMINIDÆ.	Homo sapiens,	<i>Man.</i>
				Trogloodytes niger, " gorilla,	<i>Chimpanzee.</i> <i>Gorilla.</i>
				Simia satyrus,	<i>Orang-outang.</i>
				Hylobates agilis, " syndactylus,	<i>Agile Gibbon.</i> <i>Siamang.</i>
				Semnopithecus entellus, " nasica,	<i>Sacred Monkey.</i> <i>Proboscis Monkey.</i>
				Colobus verus,	<i>Colobe.</i>
				Cercopithecus mona, Cynocephalus mormon,	<i>Guenon.</i> <i>Mandrill.</i>
				Ateles pentadactylus, Mycetes ursinus, Brachyurus cacaïao	<i>Spider Monkey.</i> <i>Bear Howler.</i> <i>Saki.</i>
				Hapale jacchus,	<i>Marmoset.</i>

<p>LEMURIDÆ.</p>	<p>Lemur macaco, <i>Cheiromys madagascariensis</i>, <i>Aye-aye</i>. <i>Perodicticus potto</i>, <i>Loris gracilis</i>,</p>	<p><i>Ruffed Lemur</i>. <i>Bush-dog</i>. <i>Graceful Loris</i>.</p>
<p>FELIDÆ.</p>	<p><i>Felis leo</i>, " <i>tigris</i>, " <i>concolor</i>, " <i>leopardus</i>, " <i>onça</i>, " <i>domestica</i>, <i>Lynx canadensis</i>, " <i>rufus</i>,</p>	<p><i>Lion</i>. <i>Tiger</i>. <i>Puma</i>. <i>Leopard</i>. <i>Jaguar</i>. <i>Domestic Cat</i>. <i>Canada Lynx</i>. <i>Wild Cat</i>.</p>
<p>VIVERRIDÆ.</p>	<p><i>Viverra civetta</i>, " <i>genetta</i>,</p>	<p><i>Civet</i>. <i>Genet</i>.</p>
<p>HYENIDÆ.</p>	<p><i>Hyena vulgaris</i>, " <i>crocuta</i>,</p>	<p><i>Striped Hyena</i>. <i>Spotted Hyena</i>.</p>
<p>CANIDÆ.</p>	<p><i>Canis lupus</i>, " <i>familiaris</i>, " <i>aureus</i>, <i>Vulpes vulgaris</i>,</p>	<p><i>Wolf</i>. <i>Dog</i>. <i>Jackal</i>. <i>Fox</i>.</p>
<p>MUSTELIDÆ.</p>	<p><i>Mustela pennanti</i>, " <i>americana</i>, <i>Putorius ermineus</i>, " <i>lutreolus</i>, <i>Mephitis mephitica</i>,</p>	<p><i>Fisher</i>. <i>Sable</i>. <i>Weasel</i>. <i>Mink</i>. <i>Skunk</i>.</p>

CARNIVORA.

SUBKINGDOM.	CLASS.	ORDER.	FAMILY.	GENUS. SPECIES.	EXAMPLES.			
MAMMALIA.	Continued.	CARNIVORA.	MUSTELIDÆ.	{ Taxidea americana, Gulo luscus, Lutra canadensis,	<i>Badger.</i> <i>Wolverine.</i> <i>Otter.</i>			
			URSIDÆ.	{ Ursus horribilis, " americanus, " maritimus,	<i>Grizzly Bear.</i> <i>Black Bear.</i> <i>White Bear.</i>			
			PROCYONIDÆ.	Procyon lotor,	<i>Raccoon.</i>			
			BASSARIDÆ.	Bassaris astuta,	<i>Civet-Cat.</i>			
			OTARIDÆ.	{ Callorhinus ursinus, Eumetopias stelleri,	<i>Sea Bear.</i> <i>Sea Lion.</i>			
			PHOCIDÆ.	Phoca vitulina,	<i>Common Seal.</i>			
			ROSMARIDÆ.	Rosmarus obesus,	<i>Walrus.</i>			
			CAMELIDÆ.	{ Camelus dromedarius, " bactrianus, Auchenia llama,	<i>Dromedary.</i> <i>Bactrian Camel.</i> <i>Llama.</i>			
			GIRAFFIDÆ.	Camelopardalis giraffa.	<i>Giraffe.</i>			
			BOVIDÆ.	{	Ovibos moschatus, Bos taurus, " americanus, " bubalus, " grunniens, " indicus,	{	Aplocerus montanus,	<i>Musk Ox.</i> <i>Domestic Ox.</i> <i>Bison.</i> <i>Buffalo.</i> <i>Yak.</i> <i>Zebu.</i> <i>Mountain Goat.</i>

		<p><i>Antilope rupicapra,</i> <i>dorcas,</i> <i>" kudu,</i> <i>" gnu,</i> <i>" oryx,</i> <i>Capra aegagrus,</i> <i>" ibex,</i> <i>Ovis montana,</i> <i>" aries,</i></p>	<p><i>Chamora.</i> <i>Gazelle.</i> <i>Koodoo.</i> <i>Gnu.</i> <i>Gemsbok.</i> <i>Goat.</i> <i>Ibex.</i> <i>Mountain Sheep.</i> <i>Domestic Sheep.</i></p>
	<p>ANTILOCAP- RIDÆ.</p>	<p><i>Antilocapra americana,</i></p>	<p>{ <i>Prong-horn Antelope.</i></p>
	<p>CERVIDÆ.</p>	<p><i>Alces malchis,</i> <i>Rangifer tarandus,</i> <i>" caribou,</i> <i>Cervus canadensis,</i> <i>" capreolus,</i> <i>" virginianus,</i> <i>" dama,</i> <i>Moschus moschiferus,</i></p>	<p><i>Moose.</i> <i>Reindeer.</i> <i>Caribou.</i> <i>Elk.</i> <i>Roebuck.</i> <i>Deer.</i> <i>Fallow Deer.</i> <i>Musk Deer.</i></p>
	<p>HIPPOTAM- IDÆ.</p>	<p><i>Hippopotamus amphibius,</i></p>	<p><i>Hippopotamus.</i></p>
	<p>SUIDÆ.</p>	<p><i>Sus scrofa.</i> <i>" babiroussa,</i></p>	<p><i>Domestic Hog.</i> <i>Babiroussa Hog.</i></p>
	<p>DICOTYLIDÆ.</p>	<p><i>Dicotyles torquatus,</i> <i>" labiatus,</i></p>	<p><i>Peccary.</i> { <i>White-tipped Pec-</i> <i>cary.</i></p>

UNGULATA.

SUBKINGDOM.	CLASS.	ORDER.	FAMILY.	GENUS. SPECIES.	EXAMPLES.		
}	MAMMALIA.	}	UNGULATA.	EQUIDÆ.	Equus caballus,	Horse.	
					" asinus,	Ass.	
					" zebra,	Zebra.	
			HYRACOIDEA.	RHINOCEROTIDÆ.	Rhinoceros unicornis,	" bicornis,	{ One-horned Rhinoceros.
					" "		{ Two-horned Rhinoceros.
			PROBOSCIDEA.	TAPIRIDÆ.	Tapirus americanus,	" bicolor,	Tapir.
					" "		Indian Tapir.
			SIRENIA.	TRICHECHIDÆ.	Hyrax syriacus,		Daman.
					Elephas indicus,	" africanus,	Indian Elephant.
			CETACEA.	DELPHINIDÆ.	Trichechus manatus,		
Phocæna americana,	" "	Manatee.					
Delphinus delphis,		Common Porpoise.					
}	}	}	}	Beluga canadensis,	Dolphin.		
				Monodon monoceros,	White Whale.		
				Balæna cisarctica,	Narwhal.		
				Physeter macrocephalus,	Right Whale.		
}	}	}	}	Phyllostoma spectrum,	Sperm Whale.		
				Megaderma frons,	Vampire.		
					Great-eared Bat.		

Continued.

CHIROPTERA.	{	VESPERTILIONIDÆ.	Vespertilio subulatus,	<i>Little Brown Bat.</i>	
		NOCTILIONIDÆ.	Noctilus leporinus,	<i>Hare-tipped Bat.</i>	
INSECTIVORA.	{	PTEROPODIDÆ.	Pteropus edulis,	<i>Flying Fox.</i>	
		GALEOPITHECIDÆ.	Galeopithecus volans,	<i>Kabung.</i>	
		TALPIDÆ.	{ Scalops aquaticus,	<i>Common Mole.</i>	
			{ Condylura cristata,	<i>Star-nosed Mole.</i>	
		SORECIDÆ.	Sorex thompsoni,	<i>Mole Shrew.</i>	
		CHRYSOCHLORIDÆ.	Chrysochloris aureus,	<i>Golden Mole.</i>	
		ERINACEIDÆ.	Erinaceus auritus,	<i>Hedgehog.</i>	
		JACULIDÆ.	Jaculus hudsonius,	<i>Jumping Mouse.</i>	
		MURIDÆ.	{	Arvicola riparia,	<i>Meadow Mouse.</i>
				Hesperomys leucopus,	<i>Deer Mouse.</i>
Mus musculus,	<i>House Mouse.</i>				
“ decumanus,	<i>House Rat.</i>				
Fiber zibethicus,	<i>Muskrat.</i>				
RODENTIA.	{	Geomys bursarius,	<i>Pouched Gopher.</i>		
		Castor canadensis,	<i>Beaver.</i>		
		Sciurus vulpinus,	{ <i>Southern Fox</i>		
“ carolinensis,	<i>Squirrel.</i>				
Pteromys volucella,	<i>Gray Squirrel.</i>				
			<i>Flying Squirrel.</i>		

SUBKINGDOM. CLASS.	ORDER.	FAMILY.	GENUS. SPECIES.	EXAMPLES.	
MAMMALIA.	RODENTIA.	SCIURIDÆ.	Tamias striatus,	} <i>Chippmunk.</i> <i>Striped Prairie Squirrel.</i> <i>Prairie-dog.</i> <i>Porcupine.</i> <i>Guinea Pig.</i>	
			Spermophilus tridecemlineatus,		
			Cynomys ludovicianus,		
		HYSTRICIDÆ.	CAVIIDÆ.	Hystrix cristata,	} <i>Northern Hare.</i> <i>Gray Hare.</i> <i>Jackass Hare.</i> <i>Giant Ant-eater.</i> <i>Stoat.</i> <i>Nine-banded Armadillo.</i> <i>Three-banded Armadillo.</i> <i>Pichiçago.</i>
				Cavia cobaia,	
				Lepus americanus, " sylvaticus, " callotis,	
	EDENTATA.	MYRMECOPHAGIDÆ.	Myrmecophaga jubata,	} <i>Kangaroo.</i> <i>Opossum.</i> <i>Porcupine Ant-eater.</i> <i>Duck-bill.</i> <i>Robin.</i> <i>Mocking-bird.</i> <i>Blue-bird.</i> <i>Robin Red-breast.</i>	
			BRADYPODIDÆ.		
			DASYPODIDÆ.		
	MARSUPIALIA.	MACROPODIDÆ.	Macropus major,	} <i>Macropus major,</i> <i>Didelphys virginiana,</i> <i>Echidna hystrix.</i> <i>Ornithorhynchus paradoxus,</i> <i>Turdus migratorius,</i> <i>Mimus polyglottus,</i> <i>Sialia sialis,</i> <i>Erythacus rubecula,</i>	
			DIDELPHIDIDÆ.		
			TACHYGLOSSIDÆ.		
	MONOTREMATATA.	ORNITHORHYNCHIDÆ.	Ornithorhynchus paradoxus,	} <i>Ornithorhynchus paradoxus,</i> <i>Turdus migratorius,</i> <i>Mimus polyglottus,</i> <i>Sialia sialis,</i> <i>Erythacus rubecula,</i>	
			TURDIDÆ.		
	SAXICOLIDÆ.	SAXICOLIDÆ.	Sialia sialis,	} <i>Sialia sialis,</i> <i>Erythacus rubecula,</i>	
Erythacus rubecula,					

Continued.

AVES.

PASSERES.

MOTACILLIDÆ.	Motacilla alba,	<i>White Wagtail.</i>
SYLVICOLIDÆ.	Philomela lusciniæ,	<i>Nightingale.</i>
HIRUNDINIDÆ.	Hirundo horreorum,	<i>Barn Swallow.</i>
AMPELIDÆ.	Ampelis cedrorum,	<i>Cedar-bird.</i>
LANIIDÆ.	Collurio borealis,	<i>Butcher-bird.</i>
TANAGRIDÆ.	Pyrranga rubra,	<i>Scarlet Tanager.</i>
FRINGILLIDÆ.	{ Melospiza melodia,	<i>Song-sparrow.</i>
	{ Curvirostra leucoptera,	<i>Cross-bill.</i>
	{ " americana,	"
	{ Alauda arvensis,	<i>Skylark.</i>
ALAUDIDÆ.	{ Eremophila cornuta,	<i>Shore Lark.</i>
	{ Dolichonyx oryzivorus,	<i>Bobolink.</i>
ICTERIDÆ.	{ Molothrus pecoris,	<i>Cow-bird.</i>
	{ Icterus baltimore,	<i>Baltimore Oriole.</i>
	{ Corvus corax,	<i>Raven.</i>
	{ " americanus,	<i>Crow.</i>
CORVIDÆ.	{ Cyanura cristata,	<i>Blue Jay.</i>
	{ Ploceus socius,	<i>Weaver-bird.</i>
PLOCEIDÆ.	{ Paradisea apoda,	<i>Paradise-bird.</i>
PARADISEIDÆ.	{ Menura superba,	<i>Lyre-bird.</i>
MENURIDÆ.	{ Myiarchus crinitus,	<i>Great-crested Fly-catcher.</i>
TYRANNIDÆ.		

SUBKINGDOM. CLASS.	ORDER.	FAMILY.	GENUS. SPECIES.	EXAMPLES.
}	PICARIDÆ.	ALCEDINIDÆ.	Ceryle alcyon,	<i>Kingfisher.</i>
		CAPRIMULGIDÆ.	{ Chordeiles popetue, Anrostomus vociferus, " carolinensis,	{ <i>Night Hawk.</i> <i>Whippoorwill.</i> <i>Chuck-will's-widow.</i>
		TROGONIDÆ.	Trogon resplendens,	<i>Resplendent Trogon.</i>
		CYPSELIDÆ.	Chætura pelagica,	<i>Chimney Seacow.</i>
		TROCHILIDÆ.	Trochilus colubris,	<i>Humming-bird.</i>
		CUCULIDÆ.	{ Geococcyx californianus, Coccygus americanus, " erythrophthalmus,	{ <i>Road-runner.</i> <i>Yellow-billed Cuckoo.</i> <i>Black-billed Cuckoo.</i>
		RHAMPHASTIDÆ.	Rhamphastos tucanus,	<i>Toucan.</i>
		PICIDÆ.	{ Campephilus principalis, Picoides hirsutus, Colaptes auratus,	{ <i>Ivory-billed Woodpecker</i> <i>Banded 3-toed "</i> <i>Golden-winged "</i>
			{ Conurus carolinensis, Cacatua sulphurea,	{ <i>Parroquet.</i> <i>Cockatoo.</i>
			Bubo virginianus,	<i>Cat-owl.</i>
PSITTACI.	PSITTACIDÆ.	Falco sparverius, Astur atricapillus, Polyborus tharus, Nauclerus furcatus, Haliaetus leucocephalus,	{ <i>Sparrow Hawk.</i> <i>Goshawk.</i> <i>Carcara Eagle.</i> <i>Scallow-tailed Hawk.</i> <i>White-headed Eagle.</i>	
	STRIGIDÆ.			
	FALCONIDÆ.			
}	RAPTORES.			

Continued.

CATHARTIDÆ.	Rhynogryphus aura, Sarcorhamphus gryphus, Pseudogryphus californianus, Catharista atrata,	Turkey-buzzard. Condor. California Condor. Black Vulture.
COLUMBÆ.	Ectopistes migratoria, Argus giganteus, Pavo cristatus, Numida meleagris, Meleagris ocellata, " gallopavo, " mexicana, Bonasa umbellus,	Passenger Pigeon. Argus Pheasant. Peacock. Guinea-fowl. Honduras Turkey. Wild Turkey. Mexican Turkey. Ruffed Grouse.
GALLINÆ.	Ortyx virginianus, Coturnix communis, Struthio camelus, Rhea darwinii, Apteryx australis, Charadrius virginicus, Hæmatopus palliatus, Recurvirostra americana, Philohela minor,	Quail. European Quail. African Ostrich. Patagonian Ostrich. Apteryx. Golden Plover. Oyster-catcher. Avocet. Woodcock.
BREVIPENNES.	STRUTHIONIDÆ. APTERYGIDÆ. CHARADRIIDÆ.	
LIMICOLÆ.	HÆMATOPODIDÆ. RECURVIROSTRIDÆ. SCOLOPACIDÆ.	

SUBKINGDOM. CLASS.	ORDER.	FAMILY.	GENUS. SPECIES.	EXAMPLES.	
}	HERODIONES.	CYCONIDÆ.	Ciconia alba,	<i>White Stork.</i>	
		PLATALEIDÆ.	Platalea ajaja,	<i>Roseate Spoonbill.</i>	
	}	ARDEIDÆ.	Ardea herodias, cinerea,	<i>Blue Heron.</i> <i>European Heron.</i>	
		TANTALIDÆ.	Tantalus loculator,	<i>Wood Ibis.</i>	
	ALECTORIDES.	GRUIDÆ.	Grus americana,	<i>Whooping Crane.</i>	
		}	RALLIDÆ.	Rallus virginianus, Gallinula martinica, Fulica americana,	<i>Virginia Rail.</i> <i>Purple Gallinule.</i> <i>Coot.</i>
			PHENICOPTERIDÆ.	Phœnicopterus ruber,	<i>Flamingo.</i>
	LAMELLIRO- TRES.	}	Cygnus buccinator, olor,	<i>Trumpeter Swan.</i> <i>Mute Swan.</i>	
			Bernicla canadensis, Aix sponsa, Somateria mollissima, Mergus americanus,	<i>Canada Goose.</i> <i>Wood Duck.</i> <i>Eider Duck.</i> <i>Goosander.</i>	
	}	STEGANO- PODES.	PELECANIDÆ.	Pelecanus erythrorhynchus, " fuscus,	<i>White Pelican.</i> <i>Brown Pelican.</i>
GRACULIDÆ.			Graculus carbo,	<i>Common Cormorant.</i>	
PLOTIDÆ.		Plotus anhingæ,	<i>Snake-bird.</i>		

Continued.

LONGIPENNES.	{	LARDÆ.	Larus marinus, " atricilla, Stercorarius parasiticus, Sterna wilsoni, Rhynchops nigra,	Great Black-backed Gull. Laughing Gull. Arctic Skua. Wilson's Tern. Scissors-bill.
		PROCELLARIIDÆ.	Diomedea exulans, Thalassidroma pelagica,	Wandering Albatross. Stormy Petrel.
		COLYMBIDÆ.	Colymbus torquatus,	Loon.
		PODICIPIDÆ.	Podiceps cornutus,	Crested Grebe.
		ALCIDÆ.	Fratercula arctica, Alca impennis,	Puffin. Great Auk.
		SPHENISCIDÆ.	Spheniscus demersus,	Penguin.
		TESTUDINIDÆ.	Cistudo virginiana,	Box Tortoise.
		EMYDIDÆ.	Chelydra serpentina,	River Tortoise.
		CHELYDIDÆ.	Chelys matamata,	Bearded Tortoise.
		TRIONYCHIDÆ.	Trionyx ferox,	Snapping Tortoise.
TESTUDINATA.	{	CHELONIDÆ.	Chelonia midas,	Green Turtle.
		CROCODILIDÆ.	Crocodilus vulgaris,	Crocodile.
LORICATA.	{	ALLIGATORIDÆ.	Alligator mississippiensis,	Alligator.
		CHAMÆLEONIDÆ.	Chamæleon vulgaris,	Chameleon.
LACERTILIA.	{	IGUANIDÆ.	Iguana tuberculata,	Iguana.
		REP-		
TILIA.	}			

SUBKINGDOM.	CLASS.	ORDER.	FAMILY.	GENUS.	SPECIES.	EXAMPLES.		
REPTILIA.	LACERTILIA.	}	AGAMIDÆ.	<i>Phrynosoma cornuta,</i>		<i>Horned Toad.</i>		
			GECKOTIDÆ.	<i>Platydactylus seychellensis,</i>		<i>Gecko.</i>		
			AMEIVIDÆ.	<i>Ameiva sexlineata,</i>		<i>Striped Lizard.</i>		
		}	OPHIDIA.	SCINCIDÆ.	<i>Ophisaurus ventralis,</i>		<i>Glass Snake.</i>	
				CROTALIDÆ.	<i>Crotalus durissus,</i>		<i>Rattlesnake.</i>	
				COLUBRIDÆ.	<i>Bascanion constrictor,</i>		<i>Black Snake.</i>	
				BOIDÆ.	<i>Boa anaconda,</i>		<i>Anaconda.</i>	
		AMPHIBIA.	URODELA.	}	HYDROPHIDÆ.		<i>Sea Snake.</i>
					RANIDÆ.	<i>Rana pipiens,</i>		<i>Bull Frog.</i>
					BUFONIDÆ.	<i>Bufo americanus,</i>		<i>Common Toad.</i>
PIPIDÆ.	<i>Pipa americana,</i>					<i>Surinam Toad.</i>		
SALAMANDRIDÆ.	<i>Salamandra maculosa,</i>					<i>Salamander.</i>		
	<i>Triton cristatus,</i>					<i>Newt.</i>		
PROTEIDÆ.	<i>Proteus anguinus,</i>					<i>Proteus.</i>		
SIRENIDÆ.	<i>Lepidosiren annectens,</i>					<i>Mud-fish.</i>		
RAIIDÆ.	<i>Pastinaca hastata,</i>					<i>Sting-ray.</i>		
ZYGÆNIDÆ.	<i>Zygæna malleus,</i>					<i>Hammer-head Shark.</i>		
}	GANOIDEI.	LEPIDOSTYDÆ.	<i>Lepidosteus osseus,</i>		<i>Gar-pike.</i>			
		ACIPENSERIDÆ.	<i>Acipenser oxyrinchus,</i>		<i>Sturgeon.</i>			

Continued.

PISCES.

SYNGNATHIDÆ.	Syngnathus peckianus,	<i>Pipe-fish.</i>
DIODONTIDÆ.	Tetraodon turgidus,	<i>Puffer.</i>
LOPHIIDÆ.	Lophius americanus,	<i>Fishing Frog.</i>
PERCIDÆ.	Perca flavescens,	<i>Yellow Perch.</i>
XIPHIIDÆ.	Xiphias gladius,	<i>Sword-fish.</i>
SCOMBERIDÆ.	Scomber vernalis,	<i>Mackerel.</i>
BLEPHARIDÆ.	Blepharis crinitus,	<i>Cobbler-fish.</i>
CHÆTODONTIDÆ.	Chætodon rostratus,	<i>Archer.</i>
GADIDÆ.	Morrhua americana,	<i>Cod.</i>
ECHENEIDÆ.	Echeneis albicauda,	<i>Remora.</i>
PLEURONECTIDÆ.	Platessa plana,	<i>Flat-fish.</i>
EXOCETIDÆ.	Exocetus volitans,	<i>Flying-fish.</i>
SILURIDÆ.	Pimelodus atrarius,	<i>Cat-fish.</i>
CLUPEIDÆ.	Clupea serrata,	<i>Herring.</i>
SALMONIDÆ.	Salmo salar,	<i>Salmon.</i>
ESOCIDÆ.	{ Esox reticulatus,	<i>Pickeral.</i>
	{ " lucius,	<i>European Pike.</i>
CYPRINIDÆ.	{ Cyprinus auratus,	<i>Gold-fish.</i>
	{ " barbus,	<i>Barbel.</i>
ANGUILLIDÆ.	Anguilla latirostris,	<i>Broad-nosed Eel.</i>

TELEOSTEI.

SUBKINGDOM.

CLASS.

PISCES.

ORDER.

MARSIPO-
BRANCHII.
PHARYNGO-
BRANCHII.

FAMILY.

PETROMYZONIDÆ

Petromyzon americanus,

EXAMPLES.

Lamprey.

BRANCHIOSTOMA.

Branchiostoma lanceolatus,

Lancelet.

APIDÆ.

{ Apis mellifica,
Bombus,

Hive-bee.
Humble-bee.

FORMICIDÆ.

{ Poneræ grandis,
Formicæ sanguinea,
Myrmecia forficata,
Mutilla cephalotos.

Giant Ant.
Red Ant.

CYNIPIDÆ.

Cynips quercus-folii,

Gall-fly.

ICHNEUMONIDÆ.

Ichneumon manifestator,

Ichneumon-fly.

PAPILIONIDÆ.

Papilio machaon,

Butterfly.

SPHINGIDÆ.

Acherontia atropos,

Death's-head Moth.

BOMBYCIDÆ.

{ Bombyx mori,
Climacampa americana,

Silk-worm Moth.
Tent Caterpillar.

CULICIDÆ.

Culex pipiens,

Mosquito.

CECIDOMYIDÆ.

{ Cecidomyia destructor,
" tritici,

Hessian-fly.
Wheat Midge.

MUSCIDÆ.

Musca domestica,

House-fly.

PULICIDÆ.

Pulex irritans.

Human Flea.

INSECTA.

CLATA.

COLEOPTERA.	SCARABÆIDÆ.	<i>Lachnosterna fusca,</i>	<i>May-beetle.</i>	
	LUCANIDÆ.	<i>Lucanus cervus,</i>	<i>Stag-beetle.</i>	
	SILPHIDÆ.	<i>Necrophorus vestigator,</i>	<i>Burying-beetle.</i>	
	CERAMBYCIDÆ.	<i>Cerambyx moschatus,</i>	<i>Musk-beetle.</i>	
	SCOLYTIDÆ.	<i>Scolytus destructor,</i>	<i>Bark-borer.</i>	
	CURCULIONIDÆ.	<i>Brenthus nasicus,</i>	<i>Curculio.</i>	
	CHRYSOMELIDÆ.	<i>Diabrotica vittata,</i>	<i>Striped Squash-bug.</i>	
	DYTISCIDÆ.	<i>Dytiscus fasciventris,</i>	<i>Water-beetle.</i>	
	CICADIDÆ.	<i>Cicada septendecim,</i>	<i>Cicada.</i>	
	COREIDÆ.	<i>Coreus tristis,</i>	<i>Squash-bug.</i>	
HEMIPTERA.	APHIDÆ.	<i>Aphis rosæ,</i>	<i>Rose-louse.</i>	
		<i>Eriosoma lanigera,</i>	<i>Apple-blight.</i>	
	LOCUSTIDÆ.	<i>Cyrtophyllus concavus,</i>	<i>Katydid.</i>	
	GRYLLIDÆ.	<i>Gryllotalpa vulgaris,</i>	<i>Mole-cricket.</i>	
	ACRYDIDÆ.	<i>Acrydium aleutaceum,</i>	<i>Locust.</i>	
	FORFICULIDÆ.	<i>Forficula auricularia,</i>	<i>Earwig.</i>	
	LIBELLULIDÆ.	<i>Libellula depressa,</i>	<i>Dragon-flies.</i>	
	MYRMELEONIDÆ.	<i>Myrmeleon obsoletus,</i>	<i>Ant-lion.</i>	
	ORTHOPTERA.			
NEUROPTERA.				

SUBKINGDOM.	CLASS.	ORDER.	FAMILY.	GENUS.	SPECIES.	EXAMPLES.
ARTICULATA.	MYRIAPODA.	CHILOPODA. DIPLOPODA.	SCOLOPENDRIDÆ. JULIDÆ.	Scolopendra gigantea, Julus canadensis,		<i>Centipede.</i> <i>Thousand-legs.</i>
	PEDIPALPI.	SCORPIONIDÆ.	Buthus carolinianus,		<i>Scorpion.</i>	
						ACARINA.
	DECAPODA.	CANCRIDÆ. ASTACIDÆ.	Cancer pagurus, Astacus fluviatilis, Hemarus americanus,		<i>Edible Crab.</i> <i>Cray-fish.</i> <i>Marine Lobster.</i>	
						CRUSTACEA.
	ENTOMOS- TRACA.	LIMULIDÆ. CYCLOPIDÆ. LERNÆIDÆ.	Limulus polyphemus, Cyclops communis, Lernæonema spratti,		} <i>King Crab.</i> <i>Cyclops.</i> <i>Sprat-sucker.</i>	
						CIRRIPIEDIA.
	BRANCHIATA.	PERIPATIDÆ. SERPULIDÆ.	Peripatus juliformis, Serpula contortuplicata,			
						ANNELIDA.

MOLLUSCA.

(295)

<p>ANNULOIDA.</p>	<p>DISTOMIDÆ. CESTOIDIDÆ. PLANARIIDÆ. GORDIIDÆ. TRICHINIDÆ. ROTIFERIDÆ. ACANTHOCEPH- ALIDÆ. GEPHYREIDÆ.</p>	<p>Distoma hepaticum, Tœnia solium, Planocera nebulosa, Gordius aquaticus, Trichina spiralis, Rotifer vulgaris, } Echinorhynchus gigas, Gephyrea.</p>	<p><i>Liver-fluke.</i> <i>Tape-worm.</i> <i>Hair-worm.</i> <i>Hair-snake.</i> <i>Muscle-worm.</i> <i>Wheel Animalcule.</i> <i>Spine-headed Worm.</i></p>
<p>DIBRANCH- IATA.</p>	<p>LOLIGINIDÆ.</p>	<p>Loligo bartramii, } Sepia octopus,</p>	<p><i>Squid.</i> <i>Cuttle-fish.</i></p>
<p>TETRA- BRANCHIATA.</p>	<p>MURICIDÆ. CYPRÆIDÆ. HARPIDÆ. HALIOTIDÆ. FISSURELLIDÆ. DENTALIDÆ.</p>	<p>Murex tenuispinus, Cypræa tigris, Harpa ventricosa, Haliotis californiensis, Fissurella listeri, Dentalium dentalis,</p>	<p><i>Cowry.</i> <i>Harp-shell.</i> <i>Ear-shell.</i> <i>Limpet.</i> <i>Tooth-shell.</i></p>
<p>PULMONIF- ERA.</p>	<p>CARINARIDÆ.</p>	<p>Carinaria mediterranea.</p>	<p><i>Carinaria mediterranea.</i></p>
<p>GASTEROP- ODA.</p>	<p>CLIIDÆ.</p>	<p>Clio borealis</p>	<p><i>Clio borealis.</i></p>

SUBKINGDOM.	CLASS.	ORDER.	FAMILY.	GENUS. SPECIES.	EXAMPLES.	
MOLLUSCA.	LAMELLI-BRANCHIATA.	{	SIPHONATA.	SOLEPIDÆ.	Solen ensis,	<i>Razor-shell.</i>
			ASIPHONATA.	CARDIIDÆ.	Cardium edulis,	<i>Cockle.</i>
	BRACHIOPODA	{	ARTHROPOMATA.	TERRIDINIDÆ.	Teredo navalis,	<i>Ship-worm.</i>
			LYOPOMATA.	MYTILIDÆ.	Mytilus edulis,	<i>Mussel.</i>
	TUNICATA.	{	SACCOBRANCHIA.	OSTRÆIDÆ.	Ostrea edulis,	<i>Oyster.</i>
				MARGARITACIDÆ.	Malleus vulgaris,	<i>Hammer Oyster.</i>
			TÆNIOBRANCHIA.	TERRATULIDÆ.	Meleagrina margaritifera,	<i>Pearl Oyster.</i>
				LYOPOMATA.	LINGULIDÆ.	Terebratula septentrionalis,
	POLYZOA.	{	SACCOBRANCHIA.	CLAVELLINIDÆ.	Lingula anatina,	<i>Tongue-shell.</i>
				TÆNIOBRANCHIA.	SALPIDÆ.	Clavellina lepidiformis.
PHYLACTOLÆMATA.			PLUMATELLIDÆ.	Plumatella.		
			GYMNO-LÆMATA.	FLUSTRIDÆ.	Flustra foliacea,	<i>Sea-mat.</i>
HOLOTHUROIDEA.	{	HOLOTHURIA.	HOLOTHURIDÆ.	Pentacta frondosa,	<i>Sea-cucumber.</i>	
		ECHINOIDEA.	ECHINIDÆ.	Echinus sphæra,	<i>Sea Urchin.</i>	
		ASTEROIDEA.	ASTERIDÆ.	Asterias vulgaris,	<i>Key-hole Urchin.</i>	
			OPHIURIDÆ.	Astrophyton agassizii,	<i>Five-fingers.</i>	
CRINOIDEA	{	CRINOIDA.	ENCRINIDÆ.	Pentacrinus asteria,	<i>Crinoid.</i>	
			ENCRINIDÆ.	Comatula rosacea,	<i>Rosy Feather Star.</i>	
ECHINODERMATA.	{	CRINOIDA.	ENCRINIDÆ.	Pentacrinus asteria,	<i>Crinoid.</i>	
			ENCRINIDÆ.	Comatula rosacea,	<i>Rosy Feather Star.</i>	

CELENTERATA.

(Linn)

CTENOPHORA.

CTENOPHORA.

CYDIPPIDÆ.

Pleurobrachia pileus,

Ctenophore.

ANTHOZOA.

ALCYONARIA.

TUBIPORIDÆ.
GORGONIDÆ.

Tubipora musica,
Corallium rubrum,
Gorgonia flabellum,

Organ-pipe Coral.
Red Coral.
Sea-fan.

ANTHOZOA.

MADREPORARIA.

MADREPORIDÆ.
FUNGIDÆ.

Madrepora aspera,
Ctenactis echinata,

Madrepore.
Mushroom Coral

ACTINARIA.

ACTINIDÆ.

Metridium marginatum,

Sea-anemone.

DISCOPHORA.

MEDUSIDÆ.

Pelagia cyanella,

Jelly-fish.

LUCERNARIDA.

LUCERNARIDÆ.

Lucernaria auricula,

Umbrella Acateph.

HYDROZOA.

SIPHONOPHORA.

PHYSALIDÆ.

Physalia utriculus,

Portuguese Man-of-war.

HYDROIDA.

SERTULARIDÆ.

Sertularia filicula,

Fern Coraline.

HYDRIDÆ.

Hydra filiformis,

Fresh water Polyp.

SPONGIDA.

CALCISPONGIA.

Syngedidia Cambogia Thersalis

INFUSORIA.

RHIZOPODA.

GREGARINIDA.

MONERA.

PROTOZOA.

INDEX,

GLOSSARIAL, EXPLANATIVE, AND REFERENTIAL.

- Abranchiata, 235, 236.
 Abranchiates, 236.
 Acalephæ (nettles), 269.
 Acanthocephalidæ, 238.
 Acariidæ, 228.
 Acarina (mite), 226, 228.
 Acephala, 250.
 Acipenser oxyrhincus (sharp-nosed), 188.
 Actinia, 269.
 Adder, 176.
 Adipose (fatty), 210.
 Æolis, 245, 248.
 Acrydidae, 222.
 Acrydium alutaceum, 221.
 Agamidæ, 172.
 Agile Gibbon, 20.
 Aix sponsa, 154.
 Alar (wing), 157.
 Alaudidæ, 120.
 Albatross, 158.
 Alca impennis (wingless), the Great Auk, 160.
 Alcedinidæ, 125.
 Alces malchis, 69.
 Alcidae, 159.
 Alectorides, 113, 145, 149.
 Alligatoridæ, 171.
 Alligator mississippiensis, 171.
 Altricial (immature), 125.
 Ambergris, 87.
 Ambulacra, 260.
 Ameividæ, 173.
 Ameiva sexlineata, 173.
 American Lion, 34.
 American Bear, 98.
 Amœba (changing) radiosa, 276.
 Amorphous (wanting form). (See p. 133.)
 Ampelidæ, 117.
 Ampelis cedrorum, 117.
 Amphibia, 179.
 Amphipneusta (double-breathing), 179.
 Anaconda, 177.
 Analogue (an organ in one species equivalent to a different organ in another, or a representative species in one country related to one in another), 34.
 Anastomosing (running into each other), 266.
 Anatidæ (duck-family), 151, 152.
 Anguillidæ, 198.
 Anguilla latirostris, 198.
 Annelida (ringed), 203, 235.
 Annelids, 235.
 Annulata, 236.
 Annuloids, 236.
 Ant-eater, Giant, 104.
 Antelope, Prong-horn, 68.
 Anthozoa, 265.
 Anthrenus (a genus of beetles), 224.
 Antelope rupicapra, 59, 64; dorcas, 59, 64; kudu, 59, 64; gnu, 59, 65; oryx, 59, 65.
 Anthropoid Apes (man-like), 20.
 Antilocapridæ, 53, 68.
 Antilocapra americana, 68.
 Ant-lion, 223.
 Antrostomus (cave-mouthed) vociferus (loud-voiced), 126.
 Ants, egg, larva and pupa of, 209; Agricultural, 209; Sanguinary, 209; Foraging, 209; Leaf-cutting, 209; White, 209.
 Anura (without a tail), 179.
 Aphidæ (exhausters), 220.
 Aphis rosæ, 201.
 Apidæ, 206.
 Aplocerus montanus, 59, 63.
 Apoda (footless), 124.
 Apollo Belvedere, 17.
 Apple-tree Borer, 217.
 Apterygidæ (without wings), 143.
 Apteryx australis, 145.
 Arachnida (spiders), 203, 226.
 Arachnida, 226.
 Araneæ, 226.
 Archæopteryx, 165.
 Archer, 192.
 Arcuate (bow-shaped), 148.
 Arctic Skua, 167.
 Ardeidæ, 148.
 Ardea herodias, 148; cinerea, 150.
 Argonautidæ, 242.
 Argonauta argo, 242.
 Argus giganteus, 139.
 Aristotle's Lantern, 261.
 Armadillo (armed), Nine-banded, 105; Three-banded, 106.
 Articulate (jointed), 203.
 Articulata (jointed), 203.
 Artiodactyls, 52, 53.
 Arvicola (field-inhabiter); A. riparia, 96.
 Ascidian (small leathern-bottle), 256.
 Asiphonata, 250, 252.

- Ass, Wild, 77.
 Astacidae, 231.
 Astacus fluviatilis, 231.
 Asteria, 261.
 Asteroidæa (star-like), 261.
 Astrophyton agassizii, 262.
 Astur atricapillus (black-headed), 134.
 Ateles pentadactylus, 25.
 Auchenia (neck) llama, 56.
 Auk, 159; impennis, 160.
 Aves (birds), 110, 113.
 Avocet, 146.
 Axolotl, 183.
 Aye-Aye (*āyē'-āyē*), 28.
 Ayrshire, 61.
 Bab-i-rous-sa, 74.
 Baboon, 25.
 Bactrian Camel, 54, 55.
 Badger, 40, 43; cut of, 44.
 Balanidae (acorn), 234.
 Balanus crenatus, 233.
 Balæna mysticetus, 86; skeleton of, 83.
 Balænidæ (whalebone), 85.
 Baleen (whalebone), 85.
 Barbel, 197.
 Bark-borer, 218.
 Barnacle, 229; Stalked, 234; Acorn, 234.
 Barn Swallow, 117.
 Bascanion constrictor, 176, 178.
 Bassaridae, 29.
 Bassaris astuta (fox-cunning), Civet
 Cat, 49.
 Bathybius, 277.
 Bat, 16; Vampire, 89; Horse-shoe or
 Geoffrey's, 88, 89; Hare-lipped, 89, 90;
 Wing-footed, 89, 91; Puff, 89; Common
 or Little Brown, 89, 90.
 Bear, 29; Black, 46; cut of, 47; Grizzly,
 46; cut of, 47; White, 46; cut of, 48;
 cut of Brown, 278.
 Bear Howler, 25; cut of, 26.
 Bear Monkey, 24.
 Beaver, 95; American, 98.
 Bee, Honey, 206; Humble, 207.
 Bee Lice, 215.
 Beetle, 206.
 Beetle, Stag, 216; Burying, 217; Striped
 Squash, 217; Long-horn Musk, 218.
 Beluga canadensis, White Whale, a
 species of porpoise, 84.
 Bernicla canadensis, 153.
 Bimāna, 16.
 Bird, plumage of, 111.
 Bird of Paradise, 124.
 Bison, American, 59, 61.
 Blepharidae, 192.
 Blepharis crinitus, 192.
 Blue-bird, 115.
 Blue Hen-hawk, 135.
 Blue Jay, 123.
 Bobolink, 120.
 Bob-white, 143.
 Boa anaconda, 177; hooks of, 177.
 Boidæ, 177.
 Bombus (buzz), 208.
 Bombycidae, 212.
 Bombyx mori, 212.
 Bonasa umbellus, 142.
 Bos taurus, 59; americanus, 59; bubalus,
 59, 62; grunniens, 59, 62; indicus,
 59, 63.
 Bovidae (ox), 53, 58, 59.
 Bowerbankia, 257.
 Brachiopoda, 242, 255.
 Brachyurus cacajao, 25.
 Branchiata, 235.
 Branchiata, 235.
 Branchiostoma lanceolatus, 199.
 Bradypodidae (slow-footed), 105.
 Bradypus tridactylus (three-toed), Com-
 mon Sloth, 105.
 Brenthus nasicus, 218.
 Brevipennes (short-winged), 113, 143.
 Bryozoa (moss animals), 257.
 Bubo virginianus, 133.
 Buffalo, 59.
 Bufonidae (toad), 180.
 Bufo americanus, 181.
 Bull-frog, 180.
 Burying-beetle, 217.
 Bush-dog, 28.
 Butcher-bird, 118.
 Buthus carolinianus, 228.
 Butterflies, 206, 211.
 Buzzard, Turkey, 136.
 Byssus (fine flax), 252.
 Cactua sulphurea, 132.
 Caillette, 52.
 Callorhinus ursinus, 49.
 Camelidae, 53, 54.
 Camelus dromedarius, 54; bactrianus, 54.
 Camel, 53; foot of, 54; water-cells of, 54.
 Camelopardalis giraffa, 58.
 Campanularia volubilis, 272.
 Campephilus principalis, 130.
 Canada Goose, 153.
 Cancridæ, 231.
 Cancer pagurus, 230.
 Canidae (*canis*, dog), 29, 37.
 Canis aureus (golden), 37, 39; lupus, 37;
 familiaris, 37, 38.
 Capra oegagrus (wild), 59; cut of, 66;
 ibex, 59; cut of, 66.
 Caprimulgidae (goat-suckers), 126.
 Caracara Eagle, 135.
 Carapace, 166.
 Cardidae, 251.
 Caribou, 69.
 Carinaria, 245; mediterranean, 248.
 Carinaridae, 249.
 Carnivora (flesh-devouring), 16; order of,
 28, 59.
 Carnivorous tooth, 29.
 Carp, European, 197.
 Castoridae, 95, 98.
 Castor canadensis, 98.
 Cattle tick, western, 229.
 Cat, Wild, 31; Domestic, 31, 35; cut
 of, 34.
 Catamount, 33.
 Cat-monkey, 92.
 Catharine, 19.
 Catharista atrata, 137.
 Cathartidae, 133, 136.
 Cat-fish, 195.
 Cat Owl, 134.

- Caviidæ, 95, 101.
 Cebidæ, 19, 25.
 Cecidomyidæ, 214.
 Cecidomyia (high-leaping fly) destructor,
 214; tritici, 214.
 Cedar-bird, 117.
 Centipede (hundred-footed), 203, 225.
 Cephalopoda (head-footed), 242
 Cerambycidæ (long-horns), 217.
 Cerambyx moschatus, 218.
 Cere (naked skin at base of bill), 113.
 Cervical (neck) vertebræ, 56.
 Cervidæ (*cervus*, deer), 53, 69.
 Cervus canadensis, 69; cut of, 71; capre-
 olus, 69, 70; virginianus, 69, 72; dama,
 69, 72.
 Ceryle alcyon, 126.
 Cestoididæ (girdle-like), 240.
 Cetacea (*cetus*, whale), 16, 82.
 Chætura pelagica, 128.
 Chætodontidæ (hair-teeth), 192.
 Chætodon rostratus (beaked), 192.
 Chamæleonidæ, 171.
 Chamæleon vulgaris, 171.
 Chamois (*shâm-mîj*), 59, 63; cut, 64.
 Charadrius virginicus, 146.
 Charming of Snakes, 175.
 Cheiromys madagascariensis, 28.
 Cheiroptera, 16, 87.
 Chelydra serpentina, 166, 167.
 Chelydidæ, 166, 167.
 Chelys matamora, 166, 167.
 Chelonidæ, 166, 168.
 Chelonia midas, 166.
 Chilopoda, 235.
 Chimney-swallow, 128.
 Chimpanzee (*Chim-pân-zee*), 20.
 Chipmunk, 100.
 Chlamyphorus (cloak-bearer) truncatus
 (truncated), 106.
 Chordeiles popetue, 126.
 Chrysochloridæ, 92.
 Chrysochloris (golden green) aureus
 (golden), 94.
 Chrysomelidæ, 217.
 Chuck-will's Widow, 127.
 Cicadidæ, 219.
 Cicada, 206; septen-decim, 220; tri-decim,
 220.
 Ciconiidæ, 147.
 Ciconia alba (white), 150.
 Cirripeds (hair-footed), 233.
 Cirripedia (curl-footed), 229, 233.
 Cirri, 233
 Ciastudo (box) virginiana, 166, 167.
 Civet, 29, 36.
 Civet Cat, 29, 49.
 Clam, 250.
 Classes, how formed, 11.
 Classification, 11.
 Clavellinidæ, 256.
 Clavellina (little knob) lepidiformis,
 256.
 Cliidæ, 249.
 Clio, 245; borealis, 249.
 Clupeidæ (shad), 195.
 Clupea serrata, 195.
 Cobbler-fish, 192.
 Cobra de Capello, 176.
 Coccycus (cuckoo) americanus, 129;
 erythrophthalmus, 129.
 Cockatoo, Great Sulphur-crested, 132.
 Cod-fish, 193.
 Cœnosarc (common flesh), 266.
 Cœlenterata, 265.
 Colaptes auratus, 131.
 Coleoptera (sheath-winged), 206, 215.
 Colobe, 20.
 Colobus polycomus, 20, 24.
 Collurio borealis, 118.
 Colubridæ (snake), 177.
 Columbæ (doves), 137.
 Columbidae, 137.
 Columba livia, 137.
 Colymbus torquatus, 159.
 Comatula rosacea, 263.
 Comparative Anatomy, laws of, 201.
 Conchifers (*kônk'-î-fers*), 250.
 Condor of the Andes, 137.
 Condylura (excrescence tail) cristata
 (crested), 94.
 Condyle (knob hinging head to spine), 15.
 Coniostres (cone-beaked), 112.
 Conurus (cone-tailed) carolinensis, 132.
 Coot, 151.
 Corallium rubrum (red coral), 266.
 Coral, Red, 266; Madreporæ, 267; Mush-
 room, 268; Organ-pipe, 263.
 Coreidæ, 220.
 Coreus tristis, 220.
 Cormorant, 156.
 Corvidæ, 122.
 Corvus corax, 122; americanus, 122;
 frugilegus, 123.
 Coryphæna hippuris, 194.
 Coturnix communis, 143.
 Cougar, (*kôô'-gar*), 33.
 Cow, Jersey, 61; Ayrshire, 61.
 Cow-bird, 121.
 Crab, Fiddler, Sand, Hermit, Soft-shell,
 231; Horse-shoe, 232; Little-red, 254.
 Crane, Whooping, 149, 150.
 Cray-fish, 231.
 Crinoid, living, 264; adult, free, 263.
 Crinoidæ (lily-like), 263.
 Crocodilidæ, 170.
 Crocodilus vulgaris, 170.
 Crocodile, 170.
 Cross-bill, 119.
 Crotalidæ (rattler), 175.
 Crotalus durissus, 175.
 Crow, Common, 122.
 Crus (hind limb), 110, 118.
 Crustacea (crust), 203, 229.
 Ctenactis echinata, 268.
 Ctenophora (comb-bearers), 265.
 Cuckoo, Black-billed, 129; Yellow-
 billed, 129.
 Cuculidæ, 129.
 Culex pipiens (piping), 213.
 Culicidæ, 213.
 Curculionidæ, 218.
 Curculio, 218.
 Curvirostra (curve-beaked) leucoptera
 (white-winged), 119.
 Cuttle-fish, 243.
 Cyanura cristata (blue-tail crested), 123.
 Cyclopidæ (circle-eye),

- Cyclops communis*.
Cygnus americanus, 152; *buccinator* (trumpeter), 152; *olor*, 153.
 Cynipidæ, 210.
Cynips quercus-folii, 210.
Cynomys ludovicianus, 101.
Cynocephalus mormon, 20, 25.
 Cypræidæ, 246.
 Cyprinidæ, 197.
Cyprinus auratus (golden), 197; *carpio*, 197; *barbus*, 197.
Cyrtophyllus concavus, 221.
 Cypselidæ (swift), 127.
 Cystic-worm, 239.
 Daddy long-legs, 228.
 Daman, 16, 78.
 Dasypodidæ (thick-footed), 105.
Dasypus novem-cinctus (nine-banded), 105; *tri-cinctus* (three-banded), 106.
 Death's-head Moth, 212.
 Decapoda (ten-footed), 229, 231.
 Deer, 53, 69; Fallow, 69, 72; Musk, 69, 73; Virginia, 72.
 Delphinidæ (dolphin), 84.
Delphinus delphis, 84.
 Dental Formula, 18.
 Dentalidæ (tooth-like), 246.
Dentalium dentalis, 246.
 Dentiostres (tooth-beaked), 112.
 Devil's Darning-needle, 223.
 Dermestes (a beetle, Coleoptera, in larval state destructive to animal substances), 224.
Diabrotica vittata, 217.
 Dibranchiata (two-gilled), 242.
 Dibranchiates, 242.
 Dicotylidæ, 53.
 Dicotyles (two-cupped) *torquatus* (colared), 75.
 Didelphidæ (twice-wombed), 108.
Didelphys virginiana, 107.
 Digitigrade (toe-walking), 40.
 Dinosauria, 165.
 Diodontidæ, 190.
Diomedea exulans (banished), 158).
 Diplopoda, 225.
 Diplopods, 225.
 Dipnoi, 185.
Dipsas margaritifera, 253.
 Diptera (two-winged), 206, 213.
 Dipters, 213.
 Distomidæ, 240.
Distoma hepaticum, 240.
 Dog, 29, 37, 38.
 Dolphin, 84, 194.
Dolichonyx oryzivorus, 120.
 Domestic Ox, 59; Sheep, 59, 60; Fowl, 143.
 Dor-bug, 216.
 Doves, 113.
 Dragon-fly, 206, 223.
 Dromedary, 54.
 Duck, 113; Wood, 154; Summer, 154; Eider, 154.
 Duck-bill, 16.
 Durham, 60.
 Dytiscidæ, 218.
Dytiscus fasciventris, 219.
 Eagle, White-headed, 136; Caracara, 135.
 Earth-worm, 235.
 Earwig, 223, 225.
 Echeneidæ, 193.
Echeneis albicauda, 193.
Echidna hystrix (porcupine), 108.
 Echinodermata, 259.
 Echinoidæ (spiny), 260, 259.
Echinus sphaera, 260.
Echinorhynchus gigas, 238.
 Ectoderm (skin without), 265.
 Ectopistes (traveller) *migratoria* (migrating), 138.
 Edentata (toothless), 16, 104.
 Edible Crab, 230.
 Edible-earth, 274.
 Eel, Broad-nosed, 198.
 Eggs, hatching, 112.
Elasmobranchii (strap-gilled), 186.
 Elephant, 16; Asiatic, 81; African, 81.
 Elephantidæ, 79.
Elephas africanus, 81; *indicus*, 81.
 Elytra, 215.
 Endoderm (skin-within), 265.
 Entomostraca (insect-shell), 233.
Epeira diadema, 227.
 Equidæ, 53, 75.
Equus asinus, 77; *caballus*, 76; *zebra*, 77.
Eremophila cornuta (horned), 120.
 Erinaceidæ, 92, 94.
Erinaceus auritus, 94.
Eriosoma lanigera, 221.
Erythacus rubecula, 115.
 Esocidæ, 196.
Esox reticulatus, 196; *lucius*, 197.
Eumetopias stelleri, 49.
 Euplectella, 273.
Euspongia officinalis, 273.
 Exocetidæ, 194.
 Facets, 204.
 Falcon, 113.
Falco sparverius, 134.
 Falconidæ, 133, 134.
 Families, how indicated, 16.
 Family, how formed, 12.
 Felidæ (*Felis*, cat), 29, 30, 31.
Felis concolor (similar color), 31, 33; *domestica*, 31; *leo*, 31; *leopardus*, 31; *onca*, 31; *tigris*, 31.
 Fiber zibethicus, 97.
 Finches, 119.
 Fisher, 40; cut of, 41.
 Fishes, 184.
 Fishing Frog, 191.
 Fissirostres (cleft-beaked), 112.
 Fissurelidæ, 246.
Fissurella listeri, 246.
 Flagella, 275.
 Flamingo, 151.
 Flat-fish, 193.
 Flea, Sand, 232.
 Flies, 206.
 Flounder, 194.
 Flustra (sea-mat), 257, 258.
 Fly-catcher, Great-crested, 125.
 Flying-fish, 194.
 Flying Fox, 91.

- Forficulidæ, 223.
 Forficula auricularia, 223.
 Formicidæ, 208.
 Formica sanguinea (bloody), 209.
 Foraminifera, 276.
 Fox, 37, 39; cut of, 40.
 Fringillidæ, 119.
 Frontal (forehead) sinus (cavity), 59.
 Frog, Skeleton of, 179; Common, 180; Tree, 180.
 Fulica americana, 151.
 Gadidæ, 192.
 Galeopithecidæ (cat-ape), 92.
 Galeopithecus volans (flying), 92.
 Gallinæ, 113, 138.
 Gallinula martinica, 151.
 Gallinule, Purple, 151.
 Gallus bankiva, 143.
 Gammaridæ, 232.
 Ganglions, 13.
 Ganoidæ (brightness), 189.
 Gar-pike, 189.
 Gasteropoda (belly-footed), 242, 245.
 Gazelle, 59; cut of, 64.
 Gecko, 172.
 Geckotidæ, 172.
 Gemsbok, African, 59, 65.
 Genera, how formed, 12.
 Genet, 36.
 Geococcyx californianus, 129.
 Geoffrey's nycterin, 88.
 Geometrical Spider, 227.
 Geomyidæ, 95, 97.
 Geomys bursarius (pouched), 97.
 Gibbon, 22.
 Giraffidæ, 53, 56.
 Giraffe, 53, 56.
 Glass Snake, 173.
 Globigerina, 277.
 Glutton, 44.
 Gnu, African, 59, 65.
 Golden Mole, 92.
 Goat, 59, 65; Mountain, 63.
 Goat-suckers, 126.
 Goitered (swollen-neck) sheep, 68.
 Gold-fish, 197.
 Golden Robin, 121; Plover, 146.
 Goosander, 154.
 Goose, Canada, 153; Wild, 153.
 Gopher, 95, 100; Pouched, 97; tortoise, 166.
 Gordiidæ (hair), 239.
 Gordius aquaticus, 239.
 Gorgonia flabellum, 267.
 Gorilla, 20, 21.
 Goshawk, 134.
 Graculidæ, 155.
 Graculus carbo, 156.
 Grallatōres, 145.
 Grasshoppers, 206, 222.
 Great Black-backed Gull, 157.
 Grebe, Crested, 159, 160.
 Gregarina sipunculi, 277.
 Gregarinida (flocks), 277.
 Gregarious (in flocks), 121.
 Grouse, Ruffed, 142.
 Gruvidæ, 149.
 Gryllidæ, 222.
 Gryllotalpa (mole-cricket) vulgaris (common), 222.
 Guenon (*gue'non*), 20, 24.
 Guinea Fowl, 140.
 Guinea Pig, 95, 101.
 Gull, 113; Great Black-backed, 157.
 Gular (throat), 155.
 Gulo luscus, 40; cut of, 44.
 Hæmatopodidæ (blood-footed), 146.
 Hæmatopus palliatus, 146.
 Hair-snake, 238.
 Haliaetus (sea-eagle) leucocephalus (white-headed), 136.
 Halibut, 194.
 Haliotidæ (sea-ear), 246.
 Hammer Oyster, 254.
 Hapale jacchus, 25; cut of, 26.
 Hedgehog, 92, 94.
 Helicidæ (spiral), 247, 248.
 Hemiptera, 219.
 Hemipters, 206, 219.
 Herbivora (herb-devouring), 59; teeth of, 60.
 Herodiōnes, 113, 145, 147.
 Heron, 113; Great Blue, 148.
 Herring, 195.
 Hesperomys leucopus, 96.
 Hippopotamidæ (river-horse), 53, 73.
 Hippopotamus amphibius, 53, 73.
 Hirundinidæ, 117.
 Hirundo (swallow) horreorum (of the granaries), 117.
 Hirudinidæ (*hirudo*, leech), 238.
 Hirudo medicinalis (medicinal), 236, 237.
 Hog, 53; skull of, 74; babiroussa, 75.
 Holothuroidea (whole gate), 259.
 Hominidæ (*homo*, man), 16.
 Homo (man) sapiens (wise), 16.
 Honey-bee, 206; cells of, 207.
 Horned Toad, 172.
 Horned-pout, 195.
 Horn-bug, 216.
 House-fly, 214.
 Humble-bee, 207.
 Humming-bird, 128.
 Hydroidæ, 271.
 Hydrozoa, 269.
 Hyena, 29; vulgaris, 37.
 Hydra, 271, 272.
 Hylobates agilis, 20; syndactylus, 20.
 Hymenoptera, 206.
 Hyracoidea, 16, 78.
 Hyrax syriacus, 78.
 Hystriidæ (porcupine), 95, 101.
 Hystrix cristata (crested), 101.
 Ibex, 59.
 Ibis, 147; Wood, 148; religiosa, 148.
 Ichneumonidæ, 210.
 Ichneumon-fly, 210.
 Ichneumon, 36; cut of, 37.
 Icteridæ, 120.
 Icterus baltimore, 121.
 Iguana tuberculata, 172.
 Imago, 205.
 Imbricate (lap like shingles), 165.
 Infusoria (infused), 274.
 Insectivora (insect-eaters), 16, 92.

- Insects, nervous system of, 203; external skeleton of, 204; trachea of, 204; digestive apparatus, 204, 205; antennæ of, 204; respiration of, 204; eyes of, 204.**
Insistent (resting on), 113.
Itch-mite, 228.
Ivory-billed Woodpecker, 130.
Ixodidæ (adhere), 229.
Ixodes bovis, 229.
- Jackal, 39.**
Jaculidæ, 95.
Jaculus hudsonius, 96.
Jaguar, 31; cut of, 34.
Jay, Blue, 123.
Jelly-fishes, 269.
Jersey Cow, 61.
Julidæ, 226.
Julus canadensis, 225.
Jumping Mouse, 95, 96.
- Kabung, 92.**
Kangaroo, 107.
Katydid, 221.
King Crab, 233.
King-fisher, 126.
Koodoo, 64.
- Lacertilia, 171.**
Laciniate (fringe-like), 151.
Lamellate (thin-plated), 113.
Lamellibranchiata (thin-plate-gills), 250.
Lamelliostres (thin-plate-beaked), 113, 151.
Lamp-shell, 255.
Lamprey, 198.
Lancelet, 199.
Land Snails, 247.
Land Tortoises, 166.
Laridæ, 156, 157.
Larus atricilla, 153.
Lark, Shore, 120; Sky, 120.
Lasso, 270.
Laughing Gull, 153.
Leaflet, 52.
Leech, 235, 237.
Lemuridæ (ghost), 27.
Lemur macaco, 27.
Leopard, 31, 34.
Lepadidæ, 233.
Lepas anatifera, 234.
Lepidoptera, 206, 211.
Lepidosiren annectens (uniting), 185.
Lepidosteus osseus (bony), 189.
Leporidæ, 95, 102.
Leptoglossa (slender-tongued), 171.
Lepus americanus, 102; sylvaticus, 102; callotis, 103.
Lernæidæ, 233.
Lernæonema spratti, 233.
Limbellulidæ, 223.
Limacidæ, 248.
Limax antiquorum, 247.
Limicolæ (shore-dwellers), 113, 145.
Limulus mollucanus, 235.
Limulidæ, 233.
Lingula anatina, 255.
Lingulidæ (tongue), 255.
Lion, 31; cut of, 32.
- Liver-flukes, 237.**
Lizard, common striped, 173.
Llama, 56.
Lobster, 203, 229; River, 231.
Locustidæ, 222.
Locust, Leather-colored, 221.
Loliginidæ, 243.
Loligo bartramii, 243.
Longipennes (long-winged), 113, 151, 156.
Loon, 113, 159.
Lophiidæ (crested), 190.
Lophius americanus, 191.
Loricata, 169, 170.
Loris gracilis, 27; cut of, 28.
Lucanidæ, 216.
Lucanus cervus, 216.
Lumbricidæ, 237.
Lumbricus terrestris, 237.
Lutra canadensis, 40, 45.
Lynx canadensis, 31, 35; rufus, 31, 36.
Lyre Bird, 124.
- Mackerel, 192.**
Macropodidæ (long-footed), 107.
Macropus major, 107.
Madrepora aspera, 267.
Mammalia, 16.
Man, 16; dental formula, 18.
Manatee, 16.
Mandrill, 20, 25.
Man-eater, 33.
Margaritacidæ, 253.
Marsipobranchii (pouch-gilled), 198.
Marsupialia, 16, 107.
Marten, 41.
Mastiff, 38.
Mataco, 106.
May-beetle, 216.
Medusæ, 269.
Medusoids, 272.
Meleagridæ, 141.
Meleagris gallopavo, 141; ocellata, 141; mexicana, 141.
Melita quinquefora, 260.
Melospiza melodia, 119.
Menuridæ, 124.
Menura superba, 125.
Mephitis mephitica, 40; cut of, 43.
Merganser, 154.
Mergus americanus, 154.
Mesentery (membrane keeping the intestines in place), 269.
Metamorphosis of Insects, 205.
Metridium marginatum, 269.
Migration of Birds, 162.
Mimicry, 33.
Mimus polyglottus (many-tongued), 115.
Mink, 43.
Mite, 226.
Mocking-bird, 115.
Mole, 16; Common, 92; Golden, 92, 94; habitation of, 93; Star-nosed, 93, 94.
Mollusca, 241; vera, 242.
Molluscans, 241.
Molluscoidæ, 242.
Mollusk, 241.
Molothrus (clamor) pecoris (of a flock), 121.
Molting (shedding feathers), 118.

- Monēra**, 277.
Monkey, The, 16.
Monodon (one-tooth) **monoceros** (one-horn), 85.
Monotremata (one orifice), 16, 108.
Monotremes, 108.
Moose, 69.
Morrhua americana, 193.
Moschus (musk) **moschiferus** (musk-bearing), 69, 73.
Mosquitoes, 206, 213.
Motacilla alba (white), 116.
Mother Cary's chicken, 159.
Moths, 206, 211.
Mountain Goat, 59, 63; **Sheep**, 59, 67.
Mouse, 95.
Mud Eel, 183.
Murex, 245, 246.
Murex tenuispinus (tender spine), 245.
Muricida (shell-fish), 245.
Muridæ (*Mus*, gen. *muris*, a mouse), 95, 96.
Mus decumanus, large, 97; **musculus** (very small), 97.
Muscidæ (fly), 214.
Mushroom Coral, 268.
Musk Deer, 69, 73.
Musk Ox, 59.
Musk Rat, 97.
Muscle-worm, 239.
Mustela americana, 40; **pennantii**, 40.
Mustelidæ, 29, 40.
Mya arenaria, 250.
Mycetes ursinus, 25.
Mygalidæ (mouse), 227.
Mygale, nest of, 228.
Myiarchus crinitus, 125.
Myriapoda (many-footed), 203, 225.
Myrmecophaga (ant-devourer) **jubata** (maned), 104.
Myrmecophagidæ, 104.
Myrmeleonidæ (ant-lion), 223.
Myrmeleon obsoletus (hidden), 224.
Mytilidæ, 252.
Mytilus edulis (edible), 252.

Naja tripudians, 176.
Narwhal, 84.
Natatóres (swimmers), 151.
Nauclerus (pilot) **furcatus** (forked), 135.
Nautilidæ (sailor), 244.
Necrophorus (dead-carrier) **vestigator** (tracker), 217.
Nephila plumipes, 227.
Nereis, 236.
Nervous System, 13.
Neuroptera (nerve-winged), 206, 223.
Neuro-skeleton (nerve skeleton), 165.
Newt, 183.
Night Hawk, 126.
Nightingale, 116.
Noctilionidæ, 89.
Noctilus leporinus, 90.
Noctiluca (night-shiner), 275.
Noctiluca (night-shining) **millaris** (pimpley), 275.
Northern Hare, 102.
Nucleobranchiata, 245, 248.
Numida meleagris, 140.
Numididæ, 140.

Nummulites ataicæ, 276.

Obsolete (obscure), 113.
Odontophora, 246.
Oesophagus, 52.
Operculum (cover), 191.
Ophidia, 165.
Ophisaurus (snake-lizard), 173.
Opisthobranchiata, 245, 248.
Opossum, 16, 107.
Orang-outang, 20, 22.
Orchestia longicornis, 232.
Orders, how formed, 12.
Organ-pipe Coral, 268.
Oriole, Baltimore, 121.
Ornithorhynchus paradoxus (paradoxical), 109.
Ornithosauria, 165.
Orthoptera (straight-winged), 206, 222.
Orthopters, 222.
Ortyx virginianus, 143.
Osteological (bony), 39.
Ostrea edulis, 253.
Ostrich, 113, 143; **African**, 144; **S. American**, 145; **Patagonian**, 145.
Otariidæ, 29, 49.
Otter, 40, 45.
Ovibos (sheep-ox) **moschatus** (musk), 59.
Ovipositor (egg-placer), 219.
Oviparous, 15.
Ovis aries, 59, 68; **montana**, 59, 67.
Owl, 133; **Barrowing**, 101.
Ox, 53, 60; **Musk**, 59.
Oysters, 253, 253.
Oyster-catcher, 146.

Pachyglossa, 171.
Palmate (palm-shaped), 69.
Panther, 33.
Paper Sailor, 242.
Papilionidæ (butterfly), 211.
Papilio machaon, 211.
Paradisidæ (paradise), 124.
Paradise-bird, **Emerald**, 124.
Paradisæa apoda (footless), 124.
Parasitical (living on others), 129.
Parthenogenesis, 221.
Partridge, 142.
Parrot, 113; **Carolina**, 132.
Passenger Pigeon, 138.
Passeres, 113, 114.
Passerine, 112.
Pastinaca hastata (spear), 186.
Pavo (**Peacock**) **cristatus** (crested), 140.
Pavonidæ, 140.
Peacock, 140.
Pearly Nautilus, 244.
Peccary, 53, 74.
Pedipalpi (feet-feelers), 226, 228.
Pelagia cyanella, 270.
Pelecanidæ, 155.
Pelecanus (**Pelican**) **erythrorhynchus** (red-beaked), 155; **fuscus** (brown), 155.
Pelican, 113; **White**, 155; **Brown**, 155.
Penguin, 113, 159; **Jackass**, 161; **Patagonian**, 161.
Pentacta frondosa, 259.
Pentacrinus asteria, 264.
Perca flavescens, 191.

- Percidæ, 191.
 Percidicidæ, 142.
 Perdix cinerea, 142.
 Peripatidæ (walk-around), 235.
 Peripatus juliformis, 235.
 Perissodactyls, 52, 53.
 Perodicticus potto, hand of, 28.
 Petrel, Stormy, 158.
 Petromyzonidæ, 198.
 Phalangidæ, 228.
 Pharyngobranchii, 199.
 Phasianidæ, 140.
 Pheasant, Argus, 139.
 Philohela minor, 146.
 Philomela (song-lover) luscinia, 116.
 Phoca vitulina, 50.
 Phocidæ, 29, 50, 51.
 Phocæna communis, 84.
 Phœnicopteridæ (red-winged), 151.
 Phœnicopterus ruber (red), 152.
 Phrynosoma (lizard-body) cornuta
 (horned), 172.
 Phyllostoma (leaf-mouthed) spectrum,
 89.
 Phyllostomidæ, 89.
 Physalia (bubble) utriculus (bladder), 271.
 Physeteridæ, 84, 87.
 Physeter macrocephalus (large-headed),
 87.
 Picariæ, 113, 125.
 Pichiciago, 106.
 Picidæ, 130.
 Picoides hirsutus (hairy), 131.
 Pickerel, 196.
 Pike, 196.
 Pimelodus atrarius, 195.
 Pinnipeds, 49.
 Pinnigrades, 49.
 Pinotheres ostreum, 254.
 Pipe-fish, 190.
 Pipa americana, 181.
 Pipidæ, 181.
 Pisces, 184.
 Planariidæ (flat), 240a.
 Planocera nebulosa, 238.
 Plantigrade (toe-walker), 45.
 Plant-lice, 220.
 Plastron, 166.
 Plataleidæ, 147.
 Platalea ajaja (*ā-hā-hā*), 147.
 Platalea plana, 193.
 Platydactylus (wide-fingered) seychellen-
 sis, 173.
 Platyrrhine, 19, 25.
 Pleurobranchia pileus, 265.
 Pleuronectidæ, 194.
 Ploceidæ, 123.
 Plocens socius, 124.
 Plotidæ, 156.
 Plotus aninga, 156.
 Plover, 113, 145.
 Plumage, 111.
 Podicipidæ, 159.
 Podiceps cornutus, 160.
 Polyborus (very greedy) tharus, 135.
 Polyp (many-footed), 266.
 Polypidom (house of the polyp), 266.
 Polyzoa, 242, 257.
 Porcupine, 95, 101; Ant-eater, 108.
 Porpoise, Common, 84.
 Pouched Gopher, 97.
 Powder-down, 147.
 Preening (dressing its plumage), 110.
 Pristis antiquorum (of the ancients), 187.
 Proboscis Monkey, 20, 24.
 Proboscidea (proboscis), 16, 79.
 Procellariidæ (tempest), 158.
 Procyon lotor (washer), 48.
 Procyonidæ, 29, 48.
 Prong-horn, 53, 68.
 Prosobranchiata, 245.
 Protamœba (first-changing), 277.
 Proteus anguinus, 183.
 Protozoa (first-form), 274.
 Protozoa (first-life), 274.
 Pseudogryphus (false-beaked) californi-
 anus, 137.
 Pseudopodia (false-footed), 277.
 Psittaci, 113, 131.
 Psittacidæ, 131.
 Pteromys (winged-mouse) volucella, 100.
 Pteropoda, 249.
 Pteropodidæ, 91.
 Pteropods, 245, 249.
 Pteropus edulis, 91.
 Puffer, 190.
 Puffin, 159.
 Pulicidæ, 215.
 Pulex irritans, 215.
 Pulmonifera, 245, 246.
 Puma, 31, 33.
 Pupa, 205.
 Purple Gallinule, 151.
 Putorius ermineus, 40; cut of, 42; Intre-
 olus, 40; cut of, 43.
 Pygopodes, 113, 151, 159.
 Pyrranga rubra, 118.
 Python, 177.
 Quadrumana, 16; Dental formula of, 19.
 Quail, Common, 143; European, 143.
 Rabbit, Gray, 102; Jackass, 103.
 Raccoon, 29.
 Raiidæ, 186.
 Rail, 113; virginian, 149.
 Rallidæ, 149.
 Rallus virginianus, 149; elegans, 149.
 Rana pipiens, 180; hyla, 180; tempo-
 raria, 180.
 Ranidæ, 180.
 Rangifer tarandus, 69; caribou, 69.
 Raptores (robbers), 113, 132, 133.
 Rat, 16.
 Rattlesnake, 175.
 Raven, 122.
 Rays, 186; egg of, 189.
 Razor-shell, 251.
 Recurvirostra (recurved-beak) ameri-
 cana, 146.
 Recurvirostridæ, 146.
 Red Coral, 267.
 Reindeer, 69, 70.
 Remora, 193.
 Reptilia (creeping), 165.
 Resplendent Trogon, 127.
 Respiration of a bird, 112.
 Reticulum, 52.

- Retractable (drawn-back), 29; cuts of, 30.
 Reversible (turned-back), 129.
 Rhamphastidæ (beaked), 130.
 Rhamphastos tucanus, 130.
 Rhea darwini, 145.
 Rhinobatidæ, 186.
 Rhinocerotidæ (horned-nose), 53, 78.
 Rhinoceros, 53; unicornis (one-horned), 78; bicornis (two-horned), 78.
 Rhinolophidæ (nose-crested), 89.
 Rhizopoda (root-footed), 275.
 Rhynchops (snout-face) nigra (black), 158.
 Rhynogryphus (curve-nose) aura, 136.
 Rice-bird, 120.
 Road-runner, 129.
 Robin-redbreast, 115.
 Robin, 114; Golden, 121.
 Rodentia, 16, 95.
 Rodent, 95.
 Roebuck, 69, 70; cut of, 71.
 Rook, 123.
 Rosmaridæ, 29, 51.
 Rosmarus obesus, 51.
 Roseate Spoonbill, 147.
 Rose Louse, 221.
 Rosy Feather-star, 263.
 Rotatoria (wheel-bearer), 238.
 Rotifers, 238.
 Rotifer vulgaris, 240.
 Rumen, 52.
 Ruminant Digestion, 52.
 Ruminants, 53.
 Sable, 40.
 Sacred Monkey, 20, 24; cut of, 23.
 Saki, 25, 26.
 Salamandra maculosa, 182.
 Salamander, 182.
 Salamandridæ, 182.
 Salmonidæ, 196.
 Salmo salar, 196.
 Salmon, 196.
 Salpidæ, 257.
 Salpa maxima, 256.
 Sand-fleas, 229, 232.
 Sarcoptes scabiei, 229.
 Sarcorhamphus (flesh-beaked) gryphus (curve), 137.
 Saw-fish, 186.
 Saxicolidæ (rock-inhabiter), 115.
 Scarlet Tanager, 118.
 Scalops aquaticus, 93.
 Scarabidæ, 216.
 Sciuridæ (shade-tail), 95, 99.
 Sciurus vulpinus, 99; carolinensis, 99.
 Sclerobasic (hard-base), 266.
 Sclerodermic (hard-skin), 268.
 Scolytidæ, 217.
 Scolytus destructor, 218.
 Scolopacidæ, 146.
 Scolopendridæ, 225.
 Scolopendra gigantea, 225.
 Scomberidæ, 192.
 Scomber vernalis, 192.
 Scorpion, 226, 228.
 Scorpionidæ, 228.
 Sea Anemone, 269.
 Sea Bear, 49.
 Sea Cow, 82.
 Sea Cucumber, 259.
 Sea Fan, 267.
 Sea Lion, 49.
 Sea Mat, 257, 258.
 Sea Nymph, 51.
 Seal, 29; Eared, 29; Common, 50.
 Semnopithecus entellus, 20; nasica, 20; cut of stomach, 23.
 Sepiæ, 243.
 Sepia octopus, 243; officinalis, 243.
 Serpula, 235.
 Serpulidæ (creeper), 236.
 Shark, Hammerhead, 187, 189; egg of, 189.
 Shark-fishing, 187.
 Sheep, Rocky Mountain, 67; Domestic, 67; Goitred, 68; Tick on, 215.
 Sheldrake, 154.
 Ship-worm, 251.
 Shore lark, 120.
 Short-horn Cow, 60.
 Shrew, 92.
 Shrike, 118.
 Sialia sialis, 116.
 Siamang, 20; cut of, 22.
 Silk-worm, 212.
 Silphidæ, 217.
 Siluridæ, 195.
 Silurus glanis, 188.
 Silver-fish, 198.
 Simia satyrus, 20.
 Simiidæ, 19.
 Siphonata (siphoned), 250, 251.
 Siphonophora, 271.
 Siredon lichenoides, 183.
 Siren, 51, 183.
 Sirenia, 16, 82.
 Skeleton, preparation of, 14; bat, 88; bear, 46; bird, 110; camel, 53; chimpanzee, 19; cow, 60; elephant, 80; fish, 185; frog, 179; giraffe, 57; horse, 76; lion, 29; man, 19; manatee, 83; mole, 92; orang, 19; seal, 50; serpent, 174; whale, 83.
 Skull, carnivorous animal, 29; hog, 74; babiroussa, 75; rodent, 95; rattlesnake, 175.
 Skunk, 40; cut of, 43.
 Sky-lark, 120.
 Sloth, 16; Three-toed, 105.
 Slug, 248.
 Snail, 245.
 Snake, Black, 176, 178; Charming of, 175; Copper-head, 175; Glass, 173; Moccasin, 175; Sea, 178; Striped, 177; Water, 177.
 Snake-bird, 156.
 Snipe, 146.
 Sociable Weaver-bird, 124; nest of, 123.
 Solenidæ, 251.
 Solen ensis, 251.
 Sole, 194.
 Somateria mollissima, 154.
 Song Sparrow, 119.
 Sorecidæ, 92.
 Sorex thompsoni, 93.
 Sparrow, Song, 119; Hawk, 134.
 Species (division of a genus), 12.
 Sperm Whale, 87.

- Spermophilus tridecim lineatus*, 100.
Sphenisci (wedge), 113, 151, 161.
Spheniscus demersus (plunger), 161.
 Sphingidæ, 211.
 Spider Monkey, 25.
 Spiders, 203, 226.
 Spinneret, 227.
 Spongida, 273.
 Spoonbill, Roseate, 147.
 Sprat-sucker, 233.
 Squid, 87, 243; Rock, 243.
 Squirrel, 95; Black, 99; Flying, 100;
 Fox, 99; Gray, 99; Striped, 100;
 Striped Prairie, 100.
 Stag-beetle, 216.
 Staggers in sheep, 239.
 Star-fish, 261.
 Star-nosed Mole, 94.
Steganopodes (covered-feet), 113, 151,
 155.
Stercorarius parasiticus, 157.
Sterna wilsoni, 157.
 Sting-ray, 186.
 Stork, 147; White, 147, 150.
 Stormy Petrel, 158.
Streptilas (stone-turner) *interpres* (di-
 viner). See *Hæmatopodidæ*.
Strepsorhinē (twisted-nose), 19; Mon-
 keys, 27.
 Strigidæ, 133.
 Striped Squash Beetle, 217.
Struthio camelus, 144.
 Struthionidæ, 143.
 Sturgeon, 188, 189.
 Sucker-fish, 193.
 Suidæ, 53, 73.
Sus scrofa, 74; *babiroussa*, 75.
 Swallow, 117; Barn, 117; Chimney, 127;
 Esculent, 127.
 Swan, Trumpeter, 152; Mute, 153;
 Americanus, 152.
 Swift, 128.
 Sword-fish, 191.
 Sylvicolidæ, 116.
Syngnathidæ (jaw-tied), 190.
Syngnathus peckianus, 190.
 Syrian dye, 245.
 Tadpole changes, 179.
Tænia solium, 240a.
Talitrus locusta, 232.
 Talpidæ, 92.
Tamias (store-keeper) *striatus* (striped),
 100.
 Tanager, Scarlet, 118.
 Tanagridæ, 118.
 Tantalidæ, 143.
Tantalus oculator, 148.
 Tape-worm, 240.
 Tapir bicolor, 79; *americanus*, 79.
 Tapiridæ, 79.
Taxidea americana, 40.
 Teleostei (complete bone), 190.
Tenuirostres (slender-beaked), 112.
 Tent. Caterpillar, 212.
 Terebratulidæ, 255.
Terebratula septentrionalis, 255.
 Teredinidæ, 252.
Teredo navalis, 251.
Termes bellicosus (warlike), 209.
 Tern, Wilson's, 157.
 Tesselated (checkered), 186.
Testudinata, 165, 166.
Testudinidæ, 166.
Tetrabranchiata (four-gilled), 242, 243.
 Tetracapoda, 229, 232.
Tetraodon (four-toothed) *turgidus* (swell-
 ing), 190.
 Tetraonidæ, 141.
Thalassidroma (sea-wanderer) *pelagica*
 (sea), 158.
 Thompson's Shrew, 93.
 Thousand-legged worm, 225.
 Thrush, 113.
 Tick, Horse, Sheep, Bird, Bat, 215.
 Tiger, 31, 33.
 Toad, Common, 181; Surinam, 181;
 Horned, 172.
 Tortoise, 165, 166; Bearded, 166, 167;
 River, 166, 167; Snapping, 166, 168.
 Toucan, 130.
 Tree Frog, 180.
 Trichechidæ, 82.
Trichechus manatus, 82.
Trichinidæ, 239.
Trichina spiralis, 239.
Trionychidæ (three-nailed), 166.
Trionyx ferox (ferocious), 166.
 Triton, 51, 183.
Triton cristatus, 182; cut of, 183.
 Trochilidæ, 128.
Trochilus colubris, 128.
Troglodytes niger, 20; gorilla, 20; cut
 of, 21.
Trogon resplendens, 127.
 Truncated (cut short), 166.
Tubipora (tube-porous) *musica*, 268.
Tunicata, 242, 255.
 Tunicates (social), 256.
 Turbot, 194.
 Turdidæ, 114.
Turdus migratorius (migratory), 114.
 Turkey, 113; Common, 141; Mexican,
 141; Ocellated (eyed), 141.
 Turkey Buzzard, 137.
 Turnstone. See *Hæmatopodidæ*.
 Turtle, nest of, 189; Green, 168.
 Tyrannidæ, 125.
Ungulata (hoofed), 16, 52, 53.
Urodæla (tail apparent), 179.
 Ursidæ, 29, 45, 46.
Ursus americanus, 46; *arctos* (northern),
 278; *horribilis*, 46; *maritimus*, 46.
 Vampire, 89.
 Vascular (composed of small vessels), 259.
 Ventral (lower): Dorsal (upper), 242, 255.
 Vertebrata (turning-joint), 15.
 Vertebrates, homologies and analogies
 of, 199; of same animal, 199; of differ-
 ent animals, 201.
 Vespertilionidæ, 89.
Vespertilio subulatus, 90.
 Vespidæ, 203.
 Viper, 176.
 Virginia Rail, 149.
 Viverridæ, 29, 36.

- Viverra civetta*, 36; *Genetta*, 36; *Ichneumon*, 37.
 Viviparous, 15.
Voluta imperialis, 245.
 Vorticels (whirlpool), 274.
Vulpes vulgaris (common), 37; cut of, 40.
 Vulture, 133; California, 137; Black, 137.
Vulturinæ, 136.
 Wagtail, White, 116.
 Walrus, 29, 51.
 Wapiti, 69, 70; cut of, 71.
 Wasps, 208.
 Water-beetles, 219.
 Water-mole, 109.
 Water-turkey, 156.
 Weasel, 29, 40; cut of, 42.
 Weaver-bird, Social, 123.
 Web of Spider, 227.
 Weevil, Plum, 218.
 Whale, 16: Greenland, 85; Sperm, 87; White, 84.
 Wheat-fly, 214.
 Whippoorwill, 126.
 White Wagtail, 116.
 White Stork, 147, 150.
 Whooping Crane, 149, 150.
 Wild Boar, 74.
 Wild Cat, 36.
 Wilson's Tern, 157.
 Wing, Motion of, 111.
 Wolf, 37, 38.
 Wolverine, 40.
 Worms, 203.
 Wood Ibis, 148.
 Woodcock, 146.
 Wood Duck, 154.
 Woodpecker, 113; Banded Three-toed, 131; Golden-winged, 131; Ivory-billed, 130.
Xiphiidæ, 191.
Xiphias gladius (sword), 191.
 Yak, 59, 62.
 Zebra, 77.
 Zebu, 59, 63.
 Zoology, 11.
 Zoophyte, 272.
Zygænidæ (yoked), 187.
Zygæna malleus, 187.
Zygodactyles, 130.



