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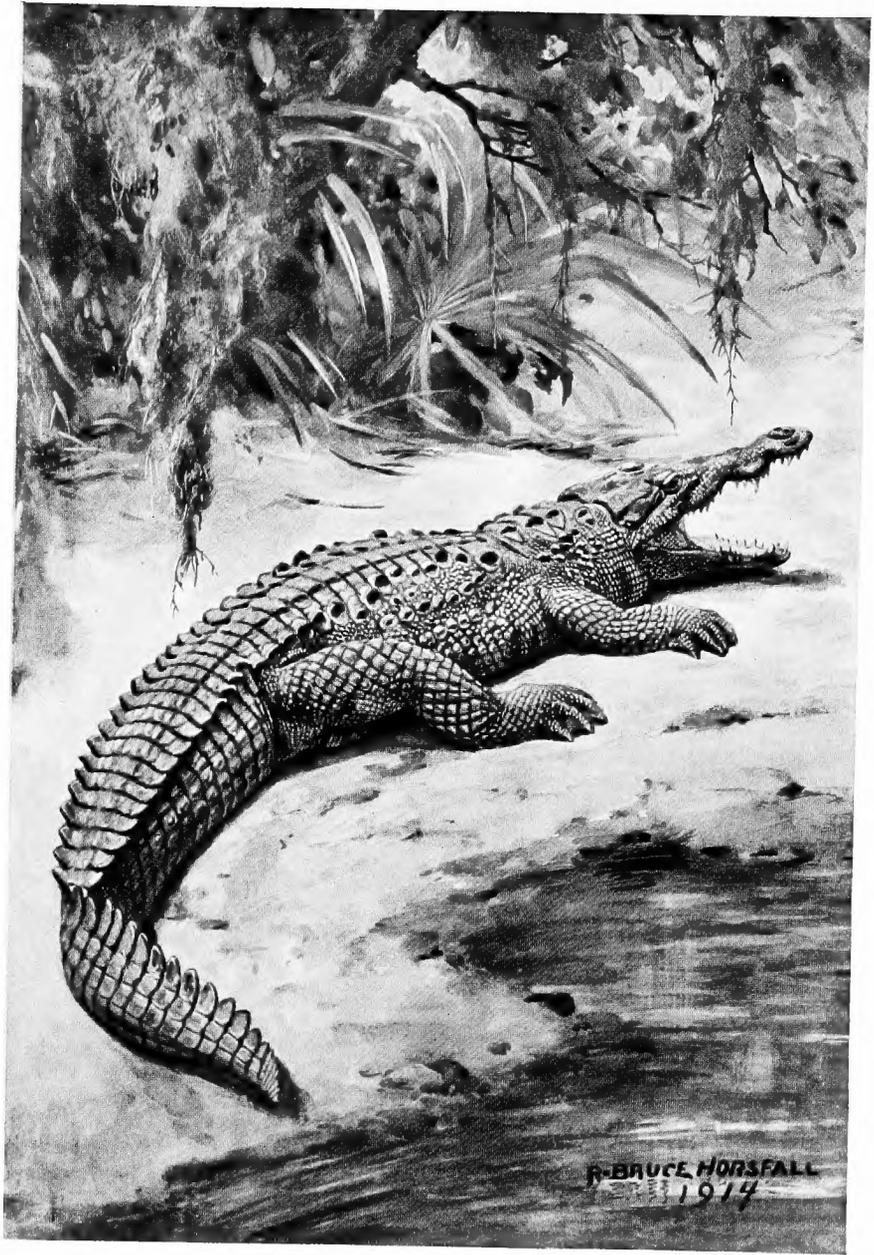
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**THE AMERICAN
NATURAL HISTORY**

FIRESIDE EDITION

VOLUME IV—REPTILES, AMPHIBIANS AND FISHES

P. 16
P. 28
III



FLORIDA CROCODILE.



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THE AMERICAN NATURAL HISTORY

A FOUNDATION OF USEFUL KNOWLEDGE OF
THE HIGHER ANIMALS OF NORTH AMERICA

BY

WILLIAM T. HORNADAY, Sc.D.,

DIRECTOR OF THE NEW YORK ZOOLOGICAL PARK

AUTHOR OF "TWO YEARS IN THE JUNGLE," "OUR VANISHING WILD LIFE," ETC.

ILLUSTRATED BY 225 ORIGINAL DRAWINGS BY BEARD, RUNGUIS,
SAWYER, AND OTHERS, 151 PHOTOGRAPHS, CHIEFLY BY SANBORN,
KELLER, AND UNDERWOOD, AND WITH NUMEROUS CHARTS AND MAPS

WITH SIXTEEN PLATES IN COLOR

FIRESIDE EDITION

VOLUME IV—REPTILES, AMPHIBIANS AND FISHES

NEW YORK
CHARLES SCRIBNER'S SONS

1914

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CONTENTS

VOLUME IV—REPTILES, AMPHIBIANS, AND FISHES

CHAPTER XXXIX

	PAGE
INTRODUCTION TO THE CLASS OF REPTILES	3
ORDERS OF LIVING REPTILES	6

CHAPTER XL

ORDER OF CROCODILES AND ALLIGATORS	
CROCODILIA	10
SYNOPSIS OF THE CROCODILIANS	10
CROCODILE FAMILY	11
AMERICAN SPECIES OF CROCODILIANS	18

CHAPTER XLI

ORDER OF TORTOISES, TERRAPINS, AND TURTLES	
CHELONIA	25
SYNOPSIS OF THE ORDER OF TORTOISES AND TURTLES	27
TORTOISE FAMILY	28

	PAGE
MUD-TERRAPIN FAMILY	32
SMOOTH-SHELLED TERRAPINS	34
SNAPPING TERRAPINS	39
SIDE-NECKED TERRAPINS	41
SOFT-SHELLED "TURTLES"	42
SEA TURTLES	44
HARD-SHELLED SEA TURTLES	45
LEATHERY-SHELLED SEA TURTLES	51

CHAPTER XLII

ORDER OF LIZARDS	LACERTILIA	52
----------------------------	------------	----

CHAPTER XLIII

ORDER OF SERPENTS	OPHIDIA	67
GENERAL CHARACTERS		67
FOOD OF SERPENTS		70
POPULAR QUESTIONS AND MISAPPREHENSIONS		72
LARGEST SPECIES OF SERPENTS		74
HARMLESS SNAKES OF THE UNITED STATES		83
POISONOUS SNAKES OF NORTH AMERICA		94
SPECIES OF RATTLESNAKES		100
SNAKE POISONS AND THEIR TREATMENT		116

CONTENTS

vii

AMPHIBIANS

CHAPTER XLIV

	PAGE
INTRODUCTION TO THE CLASS OF AMPHIBIANS . . .	125
BIRD'S-EYE VIEW OF THE CLASS AMPHIBIA	124
GENERAL CHARACTERS	127

CHAPTER XLV

ORDER OF FROGS AND TOADS ECAUDATA	129
FAMILY OF WATER FROGS	134
TREE FROG FAMILY	136
TOAD FAMILY	138
BURROWING TOADS	140
TONGUELESS FROGS	140

CHAPTER XLVI

ORDER OF TAILED AMPHIBIANS URODELA	142
FAMILY OF SALAMANDERS	143
NEWTS, OR TRITONS	148
FAMILY OF AMPHIUMAS	149
FREE-GILLED SALAMANDERS	153
TWO-LEGGED SALAMANDERS	155
ORDER OF WORM-LIKE AMPHIBIANS	156

FISHES

CHAPTER XLVII

	PAGE
INTRODUCTION TO THE CLASS OF FISHES	159
FISHERY INDUSTRIES AND FISH PROPAGATION	164
DISTRIBUTION OF EGGS AND LIVE FISH	166
THE ORDERS OF LIVING FISHES	172

CHAPTER XLVIII

ORDER OF THE CONNECTING-LINK FISHES	
SIRENOIDEI	174

CHAPTER XLIX

ORDER OF THE SPINY-FINNED FISHES: ACANTHOPTERI	177
BASSES AND SUNFISHES	177
SEA BASS FAMILY	186
PERCH AND PIKE-PERCH FAMILY	190
MISCELLANEOUS SPINY-FINNED FISHES	193
SNAPPER FAMILY	206
ODD FISHES OF THE SPINY-FINNED ORDER	208

CHAPTER L

ORDER OF PIKES	HAPLOMI 214
--------------------------	-------------

CONTENTS

ix

CHAPTER LI

	PAGE
ORDER OF TROUT AND SALMON . . . ISOSPONDYLI	218
SALMON FAMILY	218
SUBDIVISION OF NORTH AMERICAN TROUT AND CHARRS . . .	220
THE SALMON GROUP	228
AMERICAN SALMON	229

CHAPTER LII

ORDER OF FLYING FISHES . . . SYNENTOGNATHI	252
--	-----

CHAPTER LIII

ORDER OF SOLID-JAW FISHES . . . PLECTOGNATHI	254
--	-----

CHAPTER LIV

ORDER OF SUCKERS, CARP, AND MINNOWS	
PLECTOSPONDYLI	257

CHAPTER LV

ORDER OF HALF-GILLED FISHES . . . HEMIBRANCHII	265
--	-----

CHAPTER LVI

ORDER OF CATFISHES NEMATOGNATHI	268
---	-----

CHAPTER LVII

ORDER OF FLATFISHES HETEROSOMATA	273
--	-----

CHAPTER LVIII		
ORDER OF FOOT-FISHES	PEDICULATI	PAGE 277
CHAPTER LIX		
ORDER OF EELS	APODES	281
CHAPTER LX		
ORDER OF PIPEFISHES AND SEA-HORSES		
	LOPHOBRANCHI	286
CHAPTER LXI		
ORDER OF THE DOGFISH	HALECOMORPHI	290
CHAPTER LXII		
ORDER OF GAR FISHES, OR GANOIDS	GINGLYMODI	293
CHAPTER LXIII		
ORDER OF STURGEONS	GLANIOSTOMI	297
PASSING OF THE STURGEON		300
CHAPTER LXIV		
ORDER OF THE PADDLE-FISH	SELACHOSTOMI	303
CHAPTER LXV		
ORDER OF THE CHIMERAS	CHIMAEROIDEI	306
CHAPTER LXVI		
ORDER OF SHARKS	SQUALI	308

CONTENTS

CHAPTER LXVII

ORDER OF RAYS AND SKATES	RAIAE	PAGE 314
------------------------------------	-------	-------------

CHAPTER LXVIII

LOWEST CLASSES OF VERTEBRATES		321
LAMPREYS		321
LANCELETS		324
INDEX		327

ILLUSTRATIONS

COLOR PLATES

Florida Crocodile	<i>Frontispiece</i>
Reticulated Python	<small>FACING PAGE</small> 80
Remarkable Members of the Order of Solid-Jaw Fishes	164
Trigger Fish. Porcupine Fish, inflated. Box Fish. Puffer, with air-sac inflated.	
The Blue-and-Yellow Angel-Fish	192

FULL-PAGE PLATES

	<small>PAGE</small>
The Harp Turtle, or Lyre Turtle	49
Marine Iguanas on Narborough Island, Galapagos Archipelago	55
Rhinoceros Iguana	59
Yellow Anaconda	77
The Bushmaster	107
Water Moccasin and Young	111
From Tadpole to Frog	131
The Two Lives of the Axolotl	145
The Names of the Fins of a Typical Fish	161
Small-Mouthed Black Bass	181
Calico Bass	181

	PAGE
Common Sunfish	181
Yellow Perch	181
The Tuna	199
The Angler	279
Great Pipe-Fish	287
The Sea-Horse	287
Mackerel Shark, with Remora Attached	309
Hammer-Head Shark	309

TEXT ILLUSTRATIONS

	PAGE
Gavial	13
Orinoco Crocodile	13
Florida Crocodile	13
Indian Crocodile	13
Mississippi Alligator	13
Mississippi Alligator, "Old Mose"	23
Skeleton of a False Geographic Turtle	26
Galapagos Giant Tortoise	29
Box Tortoises	31
Musk "Turtle"	33
Painted "Turtle"	35
Wood "Turtle"	37
Alligator Terrapin	40
Matamata Terrapin	41

ILLUSTRATIONS

xv

PAGE

Soft-Shelled "Turtle"	43
The Hawksbill Turtle, Furnishing Tortoise Shell	47
Common Iguana	53
Blue-Tailed Lizard	58
Gila Monster	62
Horned Lizard: Desert Horned Toad	64
Glass "Snake"	65
Boa Constrictor	75
King Snake	84
Pine Snake	87
Western Coach-Whip Snake, or Red Racer	89
Common Garter Snake	91
Red-Bellied Water Snake	92
Hog-Nosed Snake	93
Hooded Cobra	97
Diamond Rattlesnake	102
Prairie Rattlesnake	103
Banded Rattlesnake (Yellow Phase)	104
Banded Rattlesnake (Dark Phase)	104
Horned Rattlesnake: "Sidewinder"	105
Massasauga	109
Copperhead	110
Fer-de-Lance: Lance-Head Snake	115
Leopard Frog	133

	PAGE
Northern Tree Frog	137
Common Toad	139
Menopoma, or Hellbender	151
The Congo "Snake," or Eel-like Salamander	152
The Menobranchus, or Mud-Puppy	154
Siren Salamander, or Mud "Eel"	155
The Australian Lung-Fish	175
Black Sea Bass	187
Striped Bass, or Rock Fish	189
Yellow Pike-Perch	191
Chain Pickerel	191
The Bluefish	194
The Spanish Mackerel	196
The Silver Mullet	205
The Red Snapper	207
The Swordfish	210
The Muskallunge	216
Rainbow Trout	222
The Eastern Brook Trout	227
The Quinнат Salmon	236
The Sebago Salmon	244
The Tarpon	246
The Common Shad	249
The Common Flying Fish	253

ILLUSTRATIONS

xvii

	PAGE
The Common Sucker	259
German Sealed Carp	261
Two-Spined Stickleback	266
Common Bullhead	269
The Common Halibut	275
The Electric Eel	283
The Dogfish	291
The Long-Nosed Gar Pike	295
Lake Sturgeon	299
The Paddle-Fish	304
Under View of the Paddle-Fish	304
Spotted Chimera	307
Shark-Ray	315
The Sawfish	316
The Sting Ray	317
The Devil-Fish	319

REPTILES

CHAPTER XXXIX

INTRODUCTION TO THE CLASS OF REPTILES

THE POINT OF VIEW.—In studying or not studying the world of reptiles, everything depends upon the point of view. With persons in middle life, who hold up their hands and shudder at the mention of the word “reptile,” there is nothing to be done. They are victims of an unreasoning prejudice that often is deliberately taught to young people, both by precept and example, until at last it becomes bone of their bone and flesh of their flesh. Human children are *not* born with the inherited fear of reptiles which is so characteristic of the apes and monkeys of the jungles; and it is not fair to terrorize their innocent souls with awful “snake stories,” any more than with the “ghost stories” which most careful parents forbid.

With young people whose minds have not been artificially warped by older persons who abhor all reptilian life, much may be done.

Now, come! Let us reason together.

Despite electricity and steam, this world is yet a fairly large place. That it has existed through countless ages, and that its animal life has gone through many marvellous transformations, no one can deny, without being put to shame by

the silent and immutable testimony of the rocks. This world, the animals now living upon it and those lying within it, entombed by Nature's hand, have been *millions of years* in forming. If you doubt it, go into an Arizona canyon, half a mile in depth, and at the bottom of a mountain-wall of rock, dig out the remains of a fossil; then ask yourself this question: "How long has it taken Nature to pile half a mile of solid rock upon the grave of this creature, *and then cut down to it again?*"

In the evolution of the birds of to-day, the reptiles of the past have played an important part; and the study of the Class *Reptilia* is very much worth while, if for no other reason than to learn the nearness of the relationships between its members and the birds.

Remember, first of all, that the reptiles of to-day are actually insignificant in comparison with those which existed ages ago, the bones of which are now fast coming to light. A 24-foot python or anaconda of to-day, lying beside a 60-foot dinosaur, with a hind leg 10 feet high, would be like a garter-snake beside a kangaroo.

In this day of liberal thought and broad reasoning, any person whose knowledge of the world of reptiles is limited to the false notion that all these creatures are either "slimy" or dangerous, is to be pitied. A persistence in that all-too-common estimate is a distinct loss to all those who entertain it. It means the shutting out, with the black curtain of Ignorance, of a whole world of interesting forms and useful facts, and also a lifetime of cringing fear, largely without cause.

Young Americans, I exhort you to take a broad and sensible view of the reptilian world—as of every other great subject. Many of these creatures are worth knowing, some because they are wonderfully interesting, some because they are useful and a very few because they are dangerous. *None of them, however, are “slimy”!* A snake may be cold to the touch, but its skin is as clean and free from slime as a watch-chain. What is more, there is no living creature, not even a dolphin, dripping from the sea, which possesses a skin displaying the beautiful pattern of colors and the rainbow iridescence of the reticulated python, of the East Indies. In reality there are a great number of reptiles that are undeniably beautiful.

I would it were possible to touch upon all the Orders of Reptiles, extinct as well as living, and introduce some of the gigantic and wonderful lizards that were like kangaroos, rhinoceroses and sea-lions, and also like nothing else under the sun; but in this work it is impossible. There is space available only for the four Orders of living Reptiles; the seven that are extinct can be studied elsewhere by those who become specially interested in this subject.¹

THE GRAND DIVISIONS OF LIVING REPTILES.—There are, all told, eleven Orders of the Class *Reptilia*; but seven of them are extinct, and for the present these will be left out of consideration. The four Orders of living reptiles are made up as shown in the following synopsis:

¹ American readers are particularly referred to the two very excellent and valuable books by Raymond L. Ditmars, Curator of Reptiles in the New York Zoological Park, entitled “The Reptile Book” (Doubleday, Page & Co., New York) and “Reptiles of the World” (Sturgis & Walton Co., New York).

THE ORDERS OF LIVING REPTILES

ORDER	PRONUNCIATION	GROUPS INCLUDED	EXAMPLES
CROCODILIA	<i>Croc-o-dil'i-a</i>	Gavials, Crocodiles, Alligators.	Florida Crocodile, Alligator.
CHELONIA	<i>Ke-lo'ni-a</i>	Tortoises, Terrapins and Sea Turtles.	Box Tortoise, Painted Terrapin, Hawksbill Turtle.
LACERTILIA	<i>La-ser-til'i-a</i>	Iguanas, Slow-Worms, Skinks.	Marine Iguana, Glass "Snake," Blue-Tailed Lizard.
OPHIDIA	<i>O-fid'i-a</i>	Colubrine Snakes, Rattlesnakes, Harlequin Snakes.	Anaconda, Timber Rattlesnake, Coral Snake.

GENERAL CHARACTERS OF REPTILES.—Chiefly through certain extinct species the reptiles lead so directly into the birds that the two Classes overlap each other.

In the Berlin Museum are the well-preserved fossil remains of a bird called the *Archae-op'ter-yx*, which had a long, lizard-like tail fully covered with feathers, and lizard-like teeth in its beak. In 1873 Professor Marsh discovered, in the chalk-beds of western Kansas, a low-formed, penguin-like bird, called the *Hesper-or'nis*, also provided with teeth.

All reptiles are cold-blooded animals, and breathe air by means of lungs. Because of the low temperature of their blood, and their slow heart-action, many of them are able to remain under water for quite lengthy periods—of minutes, not hours. Some turtles and terrapins become so thoroughly dormant at the approach of winter that the vital organs actually suspend their functions, for a period of from one to three months. It is then that these creatures bury themselves in the mud at the bottom of ponds, and so pass the winter months.

The majority of reptiles are covered with scales, or armor of solid bone, and are provided either with teeth for conflict and offence, or with armor for defence. Their means of locomotion show a wide range of variation, beginning with the clumsy-flipped harp turtle, passing the gila monster, the swift-footed monitor, the kangaroo-like collared lizard (of Arizona), the gliding serpents, and ending with the flying dragon.

In their food habits the range of the world's reptiles is infinitely great, embracing fruit, vegetables, herbage and all forms of flesh, living and dead. Oddly enough, however, no modern reptile has been provided with molar teeth for the mastication of food. The saurians, lizards and serpents have teeth for seizing and holding their living prey. The turtles, however, are quite toothless, and in place of teeth their horny jaws have sharp, cutting edges for clipping up their food into pieces small enough to be swallowed without mastication.

The teeth of serpents and crocodilians generally are perpetually renewed, as fast as old teeth are worn out and disappear. By reason of this the lives of these reptiles are indefinitely prolonged.

The great majority of reptiles reproduce by laying eggs, which are hatched either by the heat of the sun or by the fermentation of muck-heaps. Many species of serpents hatch their eggs in their own bodies, and bring forth their young alive. Such species are called *vivip'arous*. Those which lay eggs are called *o'viparous*.

Some reptiles, notably the crocodiles and tortoises, continue to grow almost as long as they live. Doubtless this is

also true of some large species of serpents, such as the great constrictors of India and South America.

DISTRIBUTION.—Reptiles reach their maximum development in the tropics and the subtropics, between the isothermals of 32° F. North and south of that zone, reptilian life still is abundantly represented, but chiefly by small species. The largest land serpents are found in the low-lying, moist and hot forests of the equatorial regions; but crocodilians of the largest size are found several hundred miles from the Equator, both north and south. The largest tortoises live close to the Equator.

POISONOUS SPECIES.—Among our reptiles only one lizard and a few species of serpents are venomous—an exceedingly small proportion of the whole number. Indeed, so few in number are the dangerous species of North America, it is an easy matter for any intelligent person to learn to recognize all of them at sight. In a few hours of diligent and conscientious study, aided by a text-book that has been properly designed, any clear-headed person over fourteen years of age can learn to determine almost at a glance whether any fully grown serpent of North America is poisonous or harmless. This is possible from the fact that more than half of the venomous species possess rattles, and those which have not are few in number.

USEFUL SPECIES.—Many reptiles are of decided value to mankind, by reason of the rats, mice and other destructive vermin which they destroy. Others diligently devour insects. Quite a number furnish useful food, and some yield skins and other commercial products of much value.

LACK OF GENERAL KNOWLEDGE REGARDING REPTILES.— While birds have been well taken care of in books, museums, zoological gardens and lectures, and mammals are now coming in for a small proportion of the attention they deserve, the reptiles have been greatly neglected. Very few zoological institutions contain collections of reptiles worthy of the name, and the books on this Class are mostly to be written. As a result of this well-nigh universal lack of opportunity for study, the great majority of persons possess very little precise and clear information regarding these creatures. The following chapters are offered merely as a foundation on which to build an acquaintance with a world of living creatures concerning which we are assured that a large number of persons sincerely desire information.

CHAPTER XL

ORDER OF CROCODILES AND ALLIGATORS

CROCODILIA

THE warm regions of the world contain nineteen species of big, burly, bony-armored reptiles, with long tails, powerful jaws, and tempers as ugly as their own rough backs. These creatures are known collectively as Croc-o-dil'i-ans, and two Families embrace all the gavials, crocodiles, alligators and caimans of both the Old World and the New.

So pointed is the need for a clear bird's-eye view of this important group of large reptiles, it is necessary to set forth a synopsis of the entire Order. The species will be arranged in a regular series according to the width of their heads, beginning with the narrowest.

A SYNOPSIS OF THE CROCODILIANS

The measurements given are believed to represent the maximum size attained by each species.

ORDER CROCODILIA

GAVIAL FAMILY

GENUS	SPECIES	COMMON NAME	LOCALITY
<i>Gar-i-al'is</i>	<i>gan-get'i-cus</i>	{ Indian Gavial, 20 feet }	Northern India.
<i>To-mis'to-ma</i>	<i>schle'gel-i</i>	{ Bornean Gavial, 15 feet }	Borneo and Su- matra.

CROCODILE FAMILY

GENUS	SPECIES	COMMON NAME	LOCALITY
<i>Croc-o-di'lus</i> ...	<i>cat-a-phrac'tus</i> ...	Sharp-Nosed African Crocodile, 12 feet.....	W. Africa.
	<i>in-ter-me'di-us</i> ...	Orinoco Crocodile, 12 feet.....	Venezuela.
	<i>johns'ton-i</i>	Australian Crocodile, 8 feet.....	Australia.
	<i>rhom'bi-fer</i>	Cuban Crocodile, 10 feet.....	Cuba only.
	<i>a-cu'tus</i>	American Crocodile, 14 feet....	Central and South America.
	<i>a. flor-i-dan'us</i> ...	Florida Crocodile, 14 feet 6 inches..	Florida.
	<i>nil-ot'i-cus</i>	Nile Crocodile, 16 feet.....	Africa generally.
	<i>po-ro'sus</i>	Salt-Water Crocodile, 16 feet....	Malayana.
	<i>pa-lus'tris</i>	Mugger, 12 feet....	India.
<i>Os-te-o-lae'mus</i> ...	<i>te-tras'pis</i>	Broad-Nosed African Crocodile, 6 feet.....	Equatorial W. Africa.
<i>Cai'man</i>	<i>tri-go-na'tus</i>	Rough-Backed Caiman, 6 feet.....	Upper Amazon.
	<i>pal-pe-bro'sus</i>	Banded Caiman, 8 feet.....	South America.
	<i>scl'e'rops</i>	Spectacled Caiman, 8 feet.....	Central and South America.
	<i>ni'ger</i>	Black Caiman, 20 feet (Bates)....	Guianas; Brazil.
	<i>lat-i-ros'tris</i>	Broad-Nosed Caiman, 8 feet.....	Amazon to Rio de la Plata.
<i>Alli-ga-tor</i>	<i>si-nen'sis</i>	Chinese Alligator, 6 feet.....	China.
	<i>miss-is-sip-pi-en'-sis</i>	Common Alligator, 16 feet.....	United States.

GENERAL CHARACTERS OF CROCODILIANS.—A crocodilian is a lizard-like reptile, of very large size, with short, thick legs, a long tail and the most highly developed vascular system to be found among reptiles. Its back and neck are protected by powerful armor consisting of rough, lozenge-shaped plates of solid bone set in a very thick and tough skin, and arranged in rows, both lengthwise and crosswise.

Both the tail, the abdomen and throat are covered by a regular arrangement of tough scales. The whole animal is covered by a thin, translucent epidermis which is impervious to water. The tail is long, flattened vertically and fringed along the top with a row of lofty, saw-toothed scales of great use in swimming.

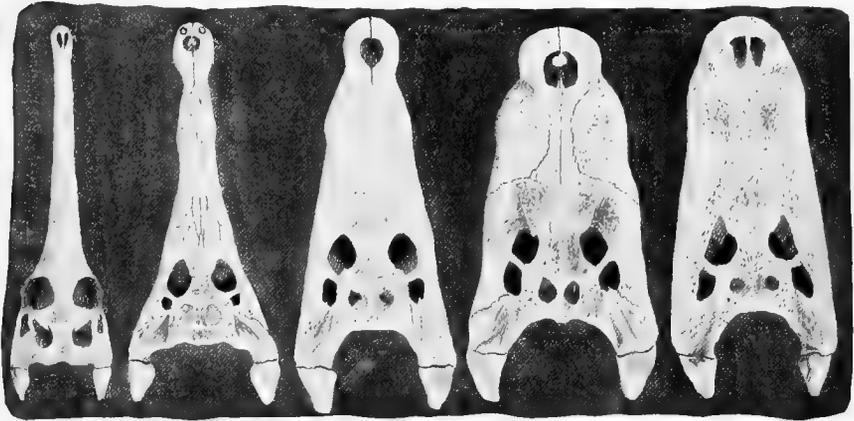
The head is a mass of well-nigh solid bone, overlaid by the same thin layer of scaly epidermis which covers the body, of the thinness of writing-paper. The nostrils are placed far forward, near the end of the snout. The jaws possess great strength, and are armed with rows of sharp-pointed, conical teeth, which are shed when worn out, and renewed.

The tongue is not free, but is firmly attached to the bottom of the mouth. Its color *never* is red, but usually is yellowish-white, and sometimes pinkish. The iris of the eye is dark green, and the pupil is very narrow, and vertical. The eyelids are movable, and the ear-opening closes tightly by a flap of skin controlled by voluntary muscles.

Most saurians are voiceless or nearly so; but the alligator emits a very deep bellow, or roar, which in animals over 10 feet in length is much lower on the scale than any fog-horn.

“The difference between a crocodile and an alligator” (a

question that has been asked a countless number of times) consists chiefly in the shape of the head, and the manner in which the teeth are placed in the lower jaw. The typical crocodile has a narrow, triangular head, terminating in a rounded point. The head of an alligator is broad, with almost parallel sides, and at the end it is broadly rounded off.



1. GAVIAL. 2. ORINOCO CROCODILE. 3. FLORIDA CROCODILE. 4. INDIAN CROCODILE. 5. MISSISSIPPI ALLIGATOR.

The canine tooth in the lower jaw of a crocodile fits on the *outside* of the upper jaw, in a notch close behind the nostrils; whereas in the alligator the same tooth fits into a pit in the upper jaw, just inside the line of the upper teeth.

The heads of living crocodilians show wide but progressive variations in breadth, as the annexed series of figures reveals. The gavial of the Ganges and Jumna, in northern India, has a snout like the handle of a saucepan, set with four rows of long and very sharp teeth. After the gavial of Borneo, its nearest relative is the Orinoco crocodile. At intervals come

in the Florida crocodile, the mugger of India, followed by the broad-headed West African crocodile, and ending with the alligator, widest of all.

ERRONEOUS IMPRESSIONS CORRECTED.—Regarding these reptiles, a number of the erroneous impressions which are now prevailing should be corrected. Some of them are as follows:

The true crocodiles are *not* confined to the Old World, four species being found in America.

Alligators are not wholly confined to America; for a small species exists in China.

The “movement” of a crocodile’s jaws differs in no manner whatever from that of an alligator.

Only a very few species of crocodilians are dangerous to man.

So far as the author is aware, there is no authentic record of the loss of a human life by our common alligator.

All crocodilians swim with their tails, not their feet.

The skin of a large crocodilian is by no means impervious to rifle bullets. A bullet sometimes strikes a bony plate and glances off; but a proper bullet, properly placed, will penetrate the skin or armor of the largest alligator or crocodile at any point.

The author believes that no crocodile or alligator of to-day exceeds 20 feet in length, by actual measurement; and one of that length is one out of ten thousand.

FOOD.—Crocodilians are not epicures, and some species devour all kinds of vertebrate animals that they can capture, from man to mud-hens. But the supply of obtainable mam-

mals and birds is very limited, and fish constitutes by far the greater portion of their daily food. If all the scaly monsters of this Order were limited in food to the mammals and aquatic birds which can be seized when drinking at the water's edge, or swimming in mid-stream, they would indeed go hungry.

It is a comparatively easy matter for a large crocodilian to seize a quadruped of medium size, draw it into deep water while struggling and drown it. On St. Vincent Island, Florida, I saw two mules whose hind quarters bore scars a foot long as the result of attacks by alligators in the small fresh-water ponds of the interior of the island. The alligators who made those bold attacks must have been rendered desperate by hunger.

In the Reptile House of the Zoological Park, during a fight between two large alligators in the pool, it was discovered how an alligator dismembers a bulky victim in order to devour it. An alligator seized a fighting enemy by one leg, and using his tail as a propeller, whirled himself round and round like a revolving shaft, until in about five seconds the leg was twisted off, close up to the body! That deadly rotary movement would have torn a leg from a small elephant.

On another occasion a 12-foot alligator named "Moses" became angry at an 8-foot companion, seized it by the body, lifted it clear of the water, and shook it until the tough skin of the back was completely torn in two at the joint immediately in front of the hind legs.

In the course of work among the crocodiles of Ceylon I found that some crocodiles will eat the flesh of their own kind,

and do so with genuine relish. Crocodiles which I skinned and left beside a pool were promptly eaten by their relatives, who in their turn were also killed, dissected and eaten.

MAN-EATING CROCODILES.—Out of the nineteen species of crocodiles and alligators (eight of which I have observed in their haunts), so far as I can learn only three are dangerous to man. The most dangerous man-eater is the salt-water crocodile of the Malay Peninsula, Borneo and surrounding regions. This reptile attains a size of 16 feet, and in the territory of Sarawak, Borneo, it devours so many people that the Government has for years paid a cash reward for its destruction. Its method is to take advantage of the murky waters of the rivers, swim up to a village bathing-place, seize any man or woman found bathing in the shallow water, or filling a water-jar, and back off into deep water.

The West African crocodiles,¹ of Angola and other portions of West Africa, are the boldest of all crocodilians, sometimes attacking people who are in canoes, and dragging a victim from a boat. (William Harvey Brown.)

The gavial and mugger of India are harmless to man, and so are the American crocodiles, and the alligator. I have gone swimming in the home waters of both the gavial and alligator—the two extremes in jaw development—and therefore feel sure that both are harmless.

NESTING HABITS.—All the crocodilians reproduce by laying from thirty to sixty oblong, perfectly white eggs, in layers, in a low mound of muck, or vegetable mould, or sand. The female lies in wait to defend her eggs while they hatch through

¹This is the Nile crocodile, which is widely distributed throughout Africa.

the heat of the sun, or by regular fermentation. From the nest of the salt-water crocodile I have taken fifty-five eggs, from the gavial forty-one and forty-four, from the Florida crocodile twenty-six, and from the alligator thirty-eight. The nest of the alligator is about 2 feet high and 4 feet in diameter.

At birth young alligators are about 8 inches long. As soon as they are out of the shell, they are wide-eyed and alert, and ready to take to the water. At this period the muzzle is short, abnormally broad, and the arch of the forehead very high.

GROWTH AND SIZE.—In the Reptile House of the New York Zoological Park we have recorded the following facts regarding the rate of growth of our alligators:

	INCHES	WEIGHT
Length when hatched	8	1¾ oz.
Length when one year old	18	9¼ oz.
Length when 22 months old	23	3 lbs.
Length when 29 months old	45	14 lbs.

An alligator when received measured	6 ft.	11 in.
During the first year it grew 1 ft. 3 in. and measured	8 ft.	2 in.
During the second year it grew 1 ft. 1½ in. and measured	9 ft.	3½ in.
During the third year it grew 1 ft. 7 in. and measured	10 ft.	10½ in.
Length of "Old Mose," July, 1899, 12 feet.		
Length of "Old Mose," July, 1903, 12 ft. 5 in.		

Judging by the rate of growth of specimens of all sizes under constant observation in the Zoological Park, where they probably are growing as rapidly as they could in a wild state, I have reached the conclusion that, under ordinary circumstances, a wild crocodile or alligator is about ten years in

attaining a length of 12 feet. The average rate of growth up to 12 feet appears to be about 1.4 inches per month. After 12 feet has been attained, the rate is much slower, being (in case of our largest specimen) about 2 inches per year.

The secret in securing rapid growth in captive crocodilians lies in giving them a pool, four feet deep, of water warmed to a temperature of between 80° and 90° F. If kept in cold water, and but little of it, they are uncomfortable, they feed sparingly and grow either very slowly or not at all.

AMERICAN SPECIES OF CROCODILIANS

THE FLORIDA CROCODILE¹ is the type which represents the midway average between the two extremes of the crocodilian series—narrow-beaked gavial and broad-snouted alligator. It is a subspecies of the so-called “American” crocodile (*Crocodilus acutus*), of Central and South America, and is not found elsewhere than in southern Florida. It is the only crocodile which inhabits a country that is visited by killing frosts.

The presence of a true crocodile in Florida was not discovered until 1875, when a pair of specimens of large size were collected in Arch Creek, at the head of Biscayne Bay, by Mr. C. E. Jackson and the writer. The male measured 14 feet 2 inches (with 4 inches of his tail missing), and the female 10 feet 8 inches. Since that date, at least seventy specimens have been taken between Lake Worth and Cape Sable. Lake Worth is the northern limit of the species, but it is most abundant in the watery labyrinth of low land and

¹ *Cro-co-di'lus a-cu'tus flor-i-dan'us*.

shallow water where the mainland of Florida reluctantly sinks into the Gulf.

The alleged "big 'gator" of Arch Creek was very wary, and permitted no boat to approach within rifle shot. Even a boat completely masked by green branches, and innocently floating with the current, was enough to send the old fellow quickly sliding from his basking-place on the bank into deep water. At last, however, we shot him from an ambush in the mangroves opposite his midday lair, and secured him. His mounted skin is now to be seen in the United States National Museum.

The adult male Florida Crocodile is very rough, externally, and usually its natural colors have been so far obliterated by age and exposure that on its upper surfaces its color is a dull, weatherbeaten gray. The females, and males under 11 feet, are of a clean, grayish-olive color—or dull yellowish-green—very different indeed from the funereal black of the alligator. This difference in color between our crocodiles and alligators is so marked it is quite noticeable at a distance of two hundred feet or more.

The Florida Crocodile digs burrows in the sandy banks of the Miami River, and other deep streams where the ground is suitable. These lairs are used as hiding-places, resting-places and doubtless also as warm retreats in which to escape the cold waves from the north, which about once every five years produce killing frosts as far south as Miami.

The entrances to these burrows are either under water, or half-submerged, and they extend into the bank from ten to thirty feet. At their extremity they are widened out suf-

ficiently to permit the owner to turn around. Usually the banks are so low that the top of a burrow is only about two feet below the surface.

This burrowing habit of the Florida Crocodile has led to a very droll and uncommon industry. A man named "Alligator Joe," of Palm Beach and Miami, knows his game so thoroughly that he has become very expert in making captures. For fifty dollars he will at any time take out a party of "tourists," go to a crocodile's burrow, and with a noose capture the reptile alive and unhurt. In each case he guarantees that the crocodile shall exceed 9 feet in length. He locates the burrows in advance, by probing for them in the sand with a sharp-pointed iron rod. With this iron rod the reptile is driven out of its lair, and rarely does Joe fail to make a capture "as advertised."

Many other persons in Florida have captured crocodiles and alligators in their burrows, by means of a long pole of tough wood with a strong and very sharp iron hook lashed on one end. When this pole is thrust into a burrow the reptile bites it viciously, and holds on stubbornly. But even if inclined to let go the sharp hook engages the tongue or other portions of the mouth, and thus the creature is dragged by sheer force into the hands of his captors, and bound with ropes.

THE CUBAN CROCODILE¹ has a narrower head than the preceding, and two more rows (six in all) of bony plates along its back. For a long time this has been regarded as one of the smallest species of crocodiles, but now it is reported

¹ *Croc-o-di'lus rhom'bi-fer.*

from Cuba that it attains a maximum length of about 10 feet. It is olive-green in color, slender in form, quick as lightning in some of its movements and much given to roaming overland, or following up tiny watercourses, in search of new hunting-grounds. I once shot a full-grown specimen in a very small brook, near the geographical centre of the Isle of Pines, Cuba, and saw others in a salt-water lagoon on the north shore of that island. So far as known, it is not found elsewhere than in Cuba.

THE AMERICAN CROCODILE inhabits the northern coast of South America, and the Gulf coast of Central America, up to Mexico. In the lagoons along the coast of Colombia, a short distance eastward from the mouth of the Magdalena River, there are small bays so thickly infested with reptiles of this species, and of such great size, that very courageous men of my acquaintance have not dared to enter in a small boat.

THE ORINOCO CROCODILE¹ is marked by a very narrow snout, by which character it is but two places removed from the slender-beaked gavials of India and Borneo. In 1876 I found this species abundant in the Orinoco River, seven miles below Ciudad Bolivar, and killed a 12-foot male specimen which was undoubtedly very old.

Of the CAI'MANS, there are five species, all of which strongly resemble our alligator, and inhabit Central and South America, and portions of the West Indies. The *Eyebrowed Caiman* has the widest distribution, and is found from southern Mexico to the Argentine Republic. The *Black Caiman*,

¹ *Croc-o-di'lus in-ter-me'di-us.*

of the Guianas and Brazil, is the largest, and is said to attain a length of 20 feet. (Bates.) The *Rough-Backed Caiman*, of the upper Amazon, is said to be quite small—only 6 feet in length. (H. Gadow.)

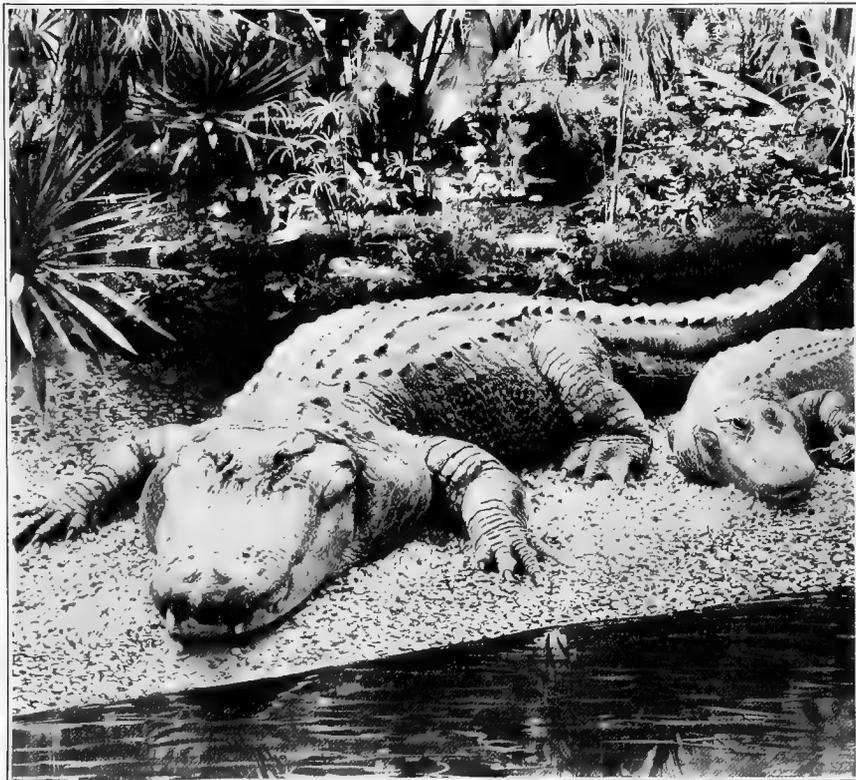
THE ALLIGATOR¹ is so well known it needs no particular description. In individuals over eight years of age, and 10 feet in length, the eight yellow bands around the tail practically though not wholly disappear, and from that time on the animal is of a uniform dull black color above, and dirty yellow or white below. I never saw a living specimen larger than "Old Mose" (12 ft. 5 in.), and only one mounted skin which exceeded 14 feet. That one measured 16 feet 3 inches, and is believed to be in a museum in Louisiana.

The Alligator finds its northern limit in southeastern North Carolina. From thence its range extends southward along the Atlantic and Gulf coasts to Cape Sable, the southern point of Florida, and westward through the Gulf states to the Rio Grande in southern Texas. Thirty-five years ago this reptile existed in certain portions of its range, especially Florida, in great abundance; but about that time Alligator leather became fashionable, and the demand thus created has reduced the visible supply of Alligators by about 98 per cent. To-day you may travel from Jacksonville to Miami without once seeing the black line upon the water which betokens the existence of an Alligator; and an experienced Florida hunter has declared his belief that there is not now living in that state a specimen 12 feet in length.

The habits of this reptile are quite similar to those of

¹ *Al-li-ga'tor miss-is-sip-pi-en'sis*.

crocodilians generally. In Florida it burrows in sand-banks precisely like the Florida crocodile, and builds a mound of



E. F. Keller, Photo.

N. Y. Zoological Park.

MISSISSIPPI ALLIGATOR, "OLD MOSE."

Captured in Indian River, Florida. Length, 12 feet 5 inches.

earth, moss and grass about two feet high, in which it lays from twenty to forty eggs.

The Alligator is the only crocodilian I ever heard utter a vocal sound of any kind. The bellow of this animal, however, is well known. Every day, regularly when the whistles

blow, the five Alligators in our Reptile House lift their heads out of the water at an angle of 45° , and bellow, or roar, in concert four or five times, making a truly unearthly noise. "Old Mose" was an excellent living understudy of "Pfafner," the bellowing dragon of Wagner's "Siegfried."

THE CHINESE ALLIGATOR was discovered in 1870 by Swinhoe, and described by Fauvel in 1879. It is quite strange that the nearest living relative of our alligator should live in the Yang-tse-Kiang River, in China; but it appears to be true. It is a small species, only about 6 feet in length, of a greenish-black color, dotted with yellow. A specimen in the author's possession so closely resembles our American species that specific differences are difficult to point out.

CHAPTER XLI

ORDER OF TORTOISES, TERRAPINS, AND TURTLES

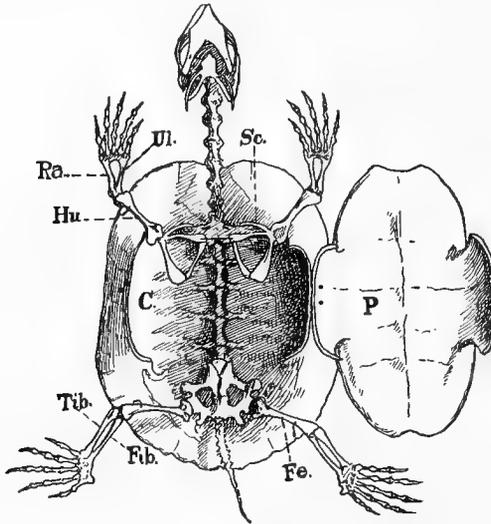
CHELONIA

SURELY there are few intelligent persons to whom a live turtle does not appeal. From the impregnable box tortoise to the grim alligator terrapin, the giant tortoise of Galapagos, and the marine monsters of the Gulf Stream, the diversity in form and habit is very great. Fortunately, however, a fixed knowledge of twelve species will give a very good foundation on which to build up this Order.

GENERAL CHARACTERS.—A member of the Order of Turtles is a reptile which has its skeleton on the outside of its body, and its vital organs completely incased in a box of bone, called a *shell*. The top half of the shell is called the *car'apace*, and it is formed by the widening of the ribs until they grow together and firmly unite wherever their edges meet. The lower portion of the shell is called the *plas'tron*. The carapace of a male tortoise is hollowed out underneath, but that of the female is flat. The shell has an opening at the front end to receive the head, neck and fore legs, and the rear is open to afford space for the hind legs and tail. The shell of a turtle is a citadel of refuge, into which its owner withdraws its head and feet whenever threatened by ene-

mies. In some species the shell is a remarkably perfect means of defence.

These reptiles have no teeth, but the edges of their strong, horny jaws are sufficiently sharp and chisel-like to enable them to cut up vegetable food. The head and neck move



SKELETON OF A FALSE GEOGRAPHIC TURTLE.

(*Graptemys pseudogeographicus*.)

P, plastron,	Ul, ulna,	Fib, fibula,
C, carapace,	Hu, humerus,	Fe, femur,
Ra, radius,	Tib, tibia,	Sc, scapula.

freely, in and out. The skin is very tough and leathery. Like other reptiles, the members of this Order reproduce by laying eggs and burying them, to be hatched by the sun. Some of the large tortoises live to the greatest age attained by any living creatures now on the earth.

In the original classification of the land-going tortoises, and the water-loving turtles and terrapins, it was an unfor-

tunate mistake that the name "tortoise" was not limited to the dry-land species, "terrapin" to the hard-shelled species inhabiting fresh water and "turtle" to the species with flippers which inhabit the sea. To-day the names "tortoise" and "turtle" are applied so indiscriminately through all three of the groups mentioned that they are useless as distinctive titles, and the mixture is mischievously confusing. In the interest of common sense I therefore propose the following revised system of these common names:

1. All Chelonians of the land only shall be called *Tortoises.*
2. All Chelonians of fresh water shall be called *Terrapins.*
3. All Chelonians of the sea shall be called *Turtles.*

To this at least one person will henceforth try to adhere.

The following is a common-sense grouping of the members of the Order Chelonia, as found in North America and the seas adjacent:

SYNOPSIS OF THE ORDER OF TORTOISES AND TURTLES

CHELONIA

SUBORDER OF LAND TORTOISES

FAMILIES

EXAMPLES

COMMON TORTOISES, } BOX TORTOISES ¹ . . . }	<i>Tes-tu-din'i-dae</i>	{ Giant Tortoise. { Gopher Tortoise. { Common Box Tortoise.
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¹ By some authorities on the classification of reptiles, the Box Tortoises are placed in the Family *Kinosternidae*, one of the divisions of the Fresh-Water Terrapins. If this arrangement should be followed, it would take the Box Tortoises out of the group of Land Tortoises, where they really belong. With this explanation the author elects to preserve the very useful arrangement into land, fresh-water and marine groups, as set forth above, and leave the Box Tortoises in the Family *Testudinidae*.

SUBORDER OF FRESH-WATER TERRAPINS

FAMILIES	{	EXAMPLES
SMOOTH-SHELLED TERRAPINS	{	<i>Kin-o-ster'ni-dae</i> Musk Terrapin.
		<i>E-mydr'i-dae</i> { Painted Terrapin. Wood Terrapin. Diamond-Back.
SNAPPING TERRAPINS	{	<i>Che-ly'dri-dae</i> { Alligator Terrapin. Snapping Terrapin.
SOFT-SHELLED TER- RAPINS		<i>Tri-o-nych'i-dae</i> Soft-Shelled Terrapin.

SUBORDER OF SEA TURTLES

HARD-SHELLED	<i>Che-lon'i-dae</i> { Hawksbill. Green Turtle.
LEATHERY-SHELLED	<i>Der-mo-che-lyd'i-dae</i> Harp Turtle.

THE TORTOISE FAMILY

Testudinidae

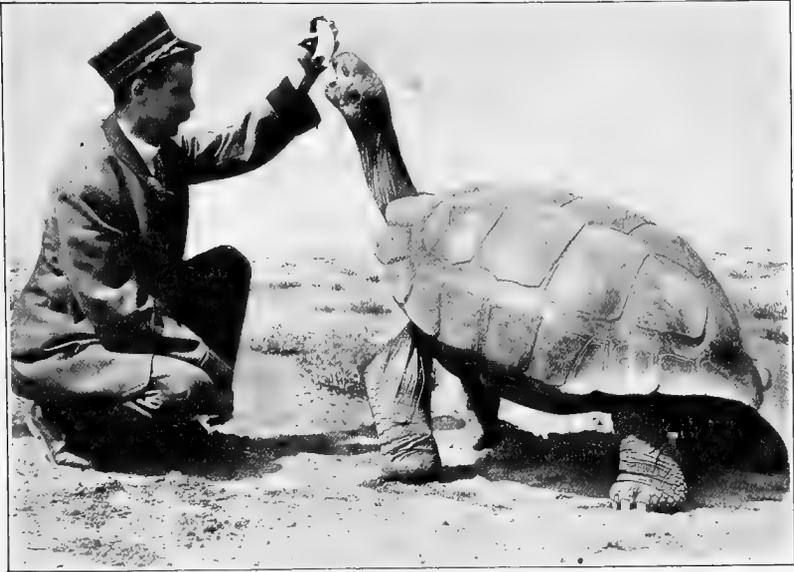
The group of tortoises contains many species that are either beautiful, or curious, or remarkable for their size and age. Quite a number of species are handsomely colored, but the majority are perfectly plain.

Two distinct types have been developed. The ordinary, thick-shelled, uncolored tortoises, some of them of great size, constitute the majority of the species. The smaller section is made up of small tortoises, some of which have a practical hinge in the centre of the lower shell. These are strictly land-going animals, and some of them even burrow in the earth, in sandy situations where digging is easy.

THE GIANT TORTOISE¹ is a good species to lead this entire Order. If there be aught in the theory of "the survival of the fittest," then this creature is clearly entitled to the lead-

¹ *Tes-tu'do vi-ci'na*.

ing position. A specimen at the New York Zoological Park, which weighed 310 pounds, and whose shell measured on its curves 4 feet 7½ inches by 4 feet 3 inches, with a height of shell of 20 inches, was probably one hundred years old. By



GALAPAGOS GIANT TORTOISE.

some authorities the age of Giant Tortoises similar to the one described has been estimated at four hundred years!

This wonderful creature lived all save the last two years of its life on the Galapagos Islands, a group of burnt-out volcanoes, and mountains of rock covered with brush, cacti and lava, directly on the Equator, five hundred miles west of Ecuador. Six species of Giant Tortoises inhabit that archipelago, living chiefly upon cacti and coarse grass, but all of them are now being exterminated at a very rapid rate,

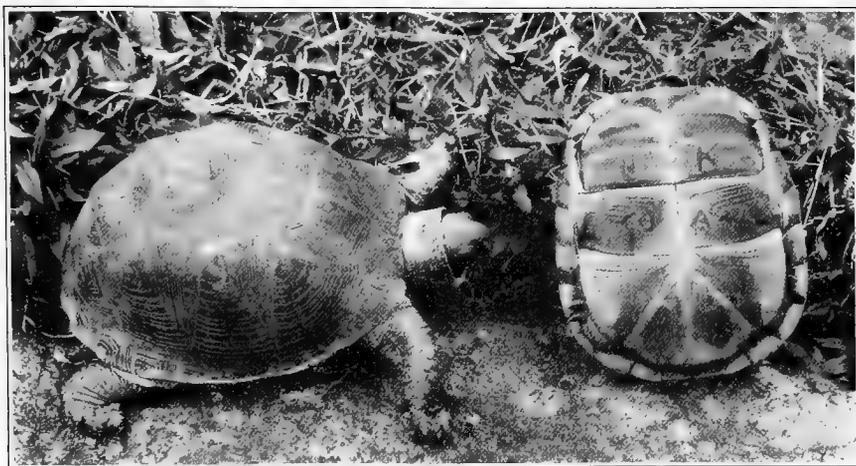
either for the paltry amount of oil they contain or a few pounds of meat from each. An ignorant cattle-herder thinks nothing of killing a tortoise one hundred years old for three pounds of meat, nothing more! In the interests of science and her own reputation, Ecuador should prohibit henceforth the wanton and wasteful killing of those remarkable creatures.

With the exception of the crocodilians, the Giant Tortoises inhabiting the Galapagos Islands, and two islands in the Indian Ocean, are the only survivors of the famous reptilian age when a warm atmosphere heavily charged with moisture called forth luxuriant vegetation, which nourished a marvellous series of gigantic reptilian forms. Beside some of these extinct creatures our largest reptiles are mere pygmies, and to-day they are equalled in bulk only by the rhinoceros, hippopotamus, elephant and whale. The great Brontosaurus, whose fossil remains were found in the bad lands of Wyoming, was 60 feet long, and some of the great Dinosaurs, or kangaroo-like lizards, stood over 30 feet in height!

Beside the Giant Tortoises, our GOPHER TORTOISE,¹ the largest allied species of tortoise we possess, seems insignificantly small. The largest specimens weigh only 15 pounds. This species is found from South Carolina to Florida, and westward to Texas. It has a very thick and strong shell, and burrows in the earth of the sandy pine forests in which it lives. Its shell is smooth and unmarked by bright colors, and its flesh is palatable food.

¹ *Tes-tu'do pol-y-phe'mus.*

THE BOX TORTOISE¹ is, to my mind, one of the small wonders of Nature, the special purpose of which is to point out how far "specialization" can go in fitting an animal to survive. After all, the most interesting things about animals



BOX TORTOISES.

are the lessons they teach bearing upon the development of the world and its inhabitants.

Excepting these and similar forms, the small Chelonians find refuge from danger in the watery depths of the ponds and streams they inhabit. The Box Tortoise, however, formed for life on land, is so small it has required a special invention for its protection.

Its shell is high, and contains sufficient room to permit the head, legs and tail to be fully withdrawn within it. Across the centre of the lower shell, or plastron, a practical double hinge has been provided. Thus, in time of danger, the ani-

¹ *Cis-tu'do carolina*.

mal completely withdraws its head, legs and tail; at both ends it draws the lower shell tightly against the upper, and all the soft parts are entirely out of reach, behind strong walls of bone. The box of bone is as tightly closed at all points as a strongly made cigar-box with the cover nailed down.

The Box Tortoise is an illustration of the fact that several species of tortoises are quite handsomely colored, in geometric patterns of black or red lines, on lighter ground-colors. A representative specimen of this species is covered with an open fretwork of black bands laid in a mechanical pattern on a lemon-yellow ground-color. North of the range of the gopher tortoise, the Box Tortoise is our only genuine tortoise—living only upon land, and never inhabiting water. It is common all around New York City, and is found even in the large northern parks, where it inhabits the well-shaded forests in situations as remote as possible from the paths of men. The moist valleys of the Zoological Park have yielded many fine specimens to the Reptile House collections, where they live contentedly. The Carolina Box Tortoise is found throughout the eastern United States from the Atlantic coast to the Mississippi River, and in the South is called the Pine-Barren "Terrapin."

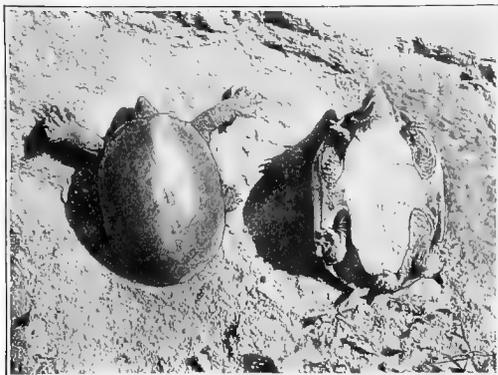
THE MUD-TERRAPIN FAMILY

Kinosternidae

The Family *Kinosternidae* was invented for the special accommodation of the box tortoises, with plastrons hinged across the middle; but in an unguarded moment the Mud

“Turtle,” Musk “Turtle” and similar terrapins with fixed plastrons were included. To-day, oddly enough, there is a decided inclination to leave the Box Tortoise in the Tortoise Family—where they belong—and leave the Musk Turtle and his nearest relatives in possession of the abandoned Order. But to the general reader, all this is of but momentary interest.

THE MUSK “TURTLE,”¹ or STINK-POT, has been loaded down with names in two languages which proclaim a smelly character. It is a commonplace little terrapin



MUSK “TURTLE.”

about 6 inches long, inhabiting quiet ponds or sluggish streams, basking in the sun when it is safe to linger above high-water mark. Occasionally it so far forgets itself as to swallow a worm-baited hook and bring on trouble of two or three kinds. Its regular food is aquatic insects, minnows, fish-eggs, worms and, in fact, any fleshy creature slow enough to be caught and small enough to be eaten.

The Musk “Turtle,” or Terrapin, is possessed of a very noticeable musky odor, which serves better as a distinguishing character in the living specimen than its very dull color and general commonplaceness of external appearance. Sometimes it shows a few spots; and the neck bears two stripes,

¹ *Ar-o-mo-chel'ys o-dor-a'tus.*

one starting above the eye, the other below it. The plastron shows a slight tendency toward a practicable hinge, but it is only a suggestion, for the shell is practically rigid, and incapable of closing. This species, like all the terrapins of the North, burrows into the mud of pond-bottoms at the approach of winter weather, and lies dormant, with the functions of Nature suspended, until spring. It is found abundantly in the eastern United States, and ranges westward into Illinois.

SMOOTH-SHELLED TERRAPINS

Emydidae

Numerous indeed is the company composing the group of pond and river Chelonians, which live half in and half out of the water. They vary in size from the little musk terrapin, no larger than the palm of your hand, to the big alligator terrapin, of Louisiana, with a shell 23 inches long, and a gross weight of 115 pounds, or more. There are many species that are valuable as food, and one which is now accepted as the symbol of epicurean luxury. As usual, only the types of greatest importance and widest distribution will be mentioned here.

If it were necessary to choose a single species to represent the many species of North American Terrapins, that choice might well fall upon the RED-BELLIED TERRAPIN,¹ or SLIDER. This is a species above the average size. The largest specimen in our collection weighs 10 pounds, and its shell is 13 inches long by 9 inches wide, axial measurement. It

¹ *Pseu'de-mys ru-bri-ven'tris*.

is handsomely and plainly marked by its back of umber brown, and reddish-white under surface. It is alert and active, its distribution is wide and its flesh is excellent. When you go to a restaurant and order diamond-backed terrapin, at a dollar a plate, you may know to a certainty what you are eating and paying for. Nine times out of ten it is Slider, no more, no less; and a very good dish it makes, too.

Of the genus to which this animal belongs, there are in North America at least six other species, all of them habitants of the southern half of our country. The Slider



PAINTED "TURTLE."

A good example of the Smooth-Shelled Terrapins.

ranges northward only as far as Delaware, and the Susquehanna River in Pennsylvania, but is frequently seen in the New York markets. Of the terrapins that are in the habit of sunning themselves on logs within diving distance of rivers, creeks or ponds, this species is, I think, the largest we are accustomed to see. Even at quite a distance it can be recognized by the height and narrowness of its shell, as compared with species of other genera.

THE PAINTED TERRAPIN,¹ hitherto called at random the PAINTED "TURTLE" and POND "TORTOISE," is perhaps the most widely distributed species, and the one available to the

¹ *Chrysem'ys pic'ta*.

greatest number of schoolrooms, in the United States. It inhabits the whole region east of the Mississippi River except the extreme southeastern states, or about one-half of the entire country. Its shell is from 6 to 8 inches in length, and its contour is rather flat. The plates of the carapace are greenish black, edged with yellow, and those around the margin are marked with bright red. The under shell (plastron) is yellow with brown markings; and the legs and tail are dark brown, marked with bright-red lines. The upper jaw is notched in front.

This small boy's favorite is a very common species, and nine times out of ten when a nice, well-behaved little Terrapin is seen sunning itself on the hurricane-deck of a derelict log, ready to drop into the water with a gentle *plash* when Small Boy approaches dangerously near, that is It. It is called the Pond Terrapin because it dislikes the nerve-wrecking hilarity of a river which rushes past at two or three miles per hour, but prefers a nice, quiet little 4 x 5 pond, where it can vegetate quite unmolested. In captivity its food consists of chopped fish and meat and angle-worms.

THE ELLACHICK,¹ of the Pacific slope, from the Sierra Nevadas to the coast, and from southern California to Vancouver, is the most important species in that region. It is good for food, and is frequently seen in the markets of the large cities on or near the coast. It is about the size of the painted terrapin.

THE DIAMOND-BACKED TERRAPIN² of the salt marshes is, most unfortunately, famous for the flavor of its flesh, and

¹ *Chel'opus mar-mo-ra'tus.*

² *Mal-a-co-clem'mys pa-lus'tris.*

its association with champagne. From the unlucky day when the epicures of Maryland pronounced terrapin stew a particularly delicious dish, the doom of this species has been sealed. Its price has risen from the original twenty-five



WOOD "TURTLE" (*Chelopus insculptus*).

Back rugose. An exception to the rule of Smooth-Shelled Terrapins.

cents each for large ones to seventy dollars per dozen for small ones, and the supply is rapidly dwindling to nothing. It is now a difficult matter for a zoologist to procure for exhibition a specimen that is more than half grown.

In appearance the Diamond-Back is neither beautiful nor striking, and in flavor I think it has been greatly over-

praised. At the same time, as reptiles go (for human food), its flesh is really very good; but, with all the good things that go into a terrapin stew, and champagne for sauce at four-fifty a bottle, almost any animal would taste good.

The Diamond-Back Terrapin is a habitant of salt water, and at one time was found in the shallow bays and salt marshes along our Atlantic and Gulf coast from Massachusetts to Texas. Chesapeake Bay has always been a sort of centre of abundance of this species, and when it flourished the markets were supplied chiefly from the region lying between New York and Pamlico Sound.

This Terrapin is small, rather flat, rounded in outline, and its scales are marked by independent black patterns composed of many geometric figures, placed one within another. A specimen with a plastron 7 inches long, and weighing a pound is a large one. Formerly the great majority measured between 4 and 5 inches; but now it is difficult to find one large enough to make a "count" by the old standard. A "count" Terrapin must measure 5 inches (in some markets it is 6 inches) in the length of the lower shell.

Beyond reasonable doubt, the continual destruction of the largest specimens will ere long render the species unproductive, and it will cease to exist. The persistent destruction of fathers and mothers will soon wipe out the strongest species in existence. It is reported, however, that in the South there are several terrapin "farms" on which this species is being bred and reared for the markets in large numbers.

THE SNAPPING TERRAPINS

Chelydridae

THE ALLIGATOR TERRAPIN,¹ of Louisiana, and other states bordering on the Gulf between Florida and Texas, is, when adult, a huge, rough-backed, big-headed creature, weighing from 100 to 125 pounds, and even attaining on rare occasions to 150 pounds. This is the largest terrapin in North America, and also the ugliest. The broad and rather flat table of its upper surface rises in a series of brown hillocks, earthy-looking, and often actually covered with moss.

The head is of huge proportions, and the strength of the jaws is very great. The tail is very long and fleshy—which is rather unusual in Chelonians. Notwithstanding the rough exterior of this creature, its flesh is eaten by many persons who share its habitat.

This remarkable reptile is found only in the semi-tropical fresh-water bayous and streams of the South. A specimen that recently lived in the Reptile House at New York measured as follows:

Length of head and neck.....	12 in.
Length of shell.....	23 in.
Length of tail.....	19 in.
Total length.....	54 in.
Width of shell.....	18 in.
Weight.....	113½ lbs.

It is a shy animal, and if not permitted to live under the crocodile's raft which floats in the pool, it will not eat its usual daily ration of raw meat or fish. It never attempts

¹ *Mac-ro-chel'ys tem-minck'i.*

to leave the water, and can remain submerged, without breathing, for periods which are so long we can only describe them as "indefinite." In its home this burly reptile feeds upon fish, frogs and other water animals.

THE SNAPPING TERRAPIN, or SNAPPING "TURTLE,"¹ which is found in the northern states as well as in the South, is a



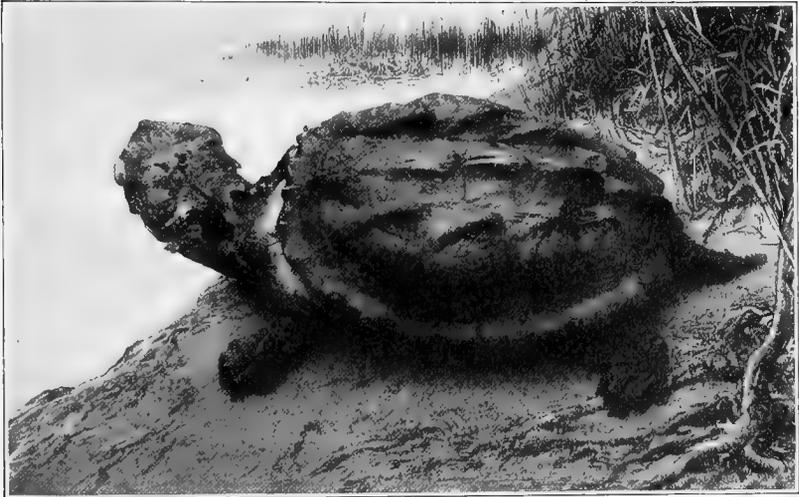
ALLIGATOR TERRAPIN.

very cross-tempered and savage understudy of the preceding species, and it is ugly in more senses than one. It has a humpy, moss-covered back, a mean eye, a dangerously sharp and hooked beak like a horned owl and a tail that reminds one of the terminal half of a bloated water moccasin.

This reptile seldom leaves the waters of the ponds in which it lives. It believes most thoroughly in the survival of the fittest, and to it the Fittest is "Number One." It is

¹ *Che-ly'dra ser-pen-ti'na.*

a chronic fighter, and inasmuch as its jaws are very strong,—and, like some men, never know when to let go,—it is a reptile to be either mastered or avoided. It is wholly carnivorous in its habits, and is very destructive to fish and young water-fowl. Never place one in any pond or stream that is intended to contain fish or young ducks.



MATAMATA TERRAPIN.

Strange to say, the Snapping Turtle is regularly consumed as food, and is often sold in the Centre Market at Washington.

THE SIDE-NECKED TERRAPINS

Chelyidae

THE MATAMATA TERRAPIN,¹ of the fresh-water streams of Venezuela, the Guianas and Brazil, is quite as odd-looking as our snapping terrapin. It has a flat shell studded

¹ *Chel'ys fim-bri-ca'ta*.

with lofty hills of bone, and its extremely broad and flat neck looks as if a roller had gone over it and flattened it out. Each side of the neck is ornamented with rows of ragged filaments of skin that look quite as if they were made to be bitten off by the voracious and deadly saw-bellied salmon. This very odd reptile is brownish gray and it is destitute of colors, but when you are vexed by a gnawing South American hunger it makes a very palatable stew.

This is not a large terrapin. The shell of a full-grown specimen is only about 14 inches in length, and its neck measures about 3 by 5 inches.

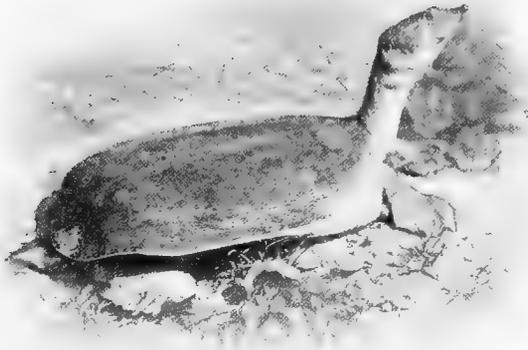
THE SOFT-SHELLED "TURTLES"

Trionychidae

This Family is of ancient lineage, and wide distribution, its members being found in the rivers of Asia, Africa and North America. Wherever found they may be recognized by very flat and nearly circular shells that are imperfectly ossified, both above and below, and which terminate at the edges in thin plates of leathery skin. The nose is prolonged into a decided proboscis, and the neck is long and flexible. In some species (found in Australia) the neck is so very long it cannot be withdrawn into the shell, but in times of danger it is laid away snugly under the upper edge of the shell, passing over one fore leg.

The members of this Family present many anatomical exceptions to the regular order of form among tortoises and terrapins, and by some authors they are placed at the foot of the Order Chelonia. The shell is really very imperfect,

the bones being literally few and far between, and the upper and lower shells are quite unconnected by bony structure. The feet are large and strongly webbed, but only the three inner toes are provided with claws. In habit these creatures are persistently aquatic, rarely going upon dry land, and they



SOFT-SHELLED "TURTLE."
Aspionectes ferox, from Florida.

are both voracious and carnivorous. They live upon fish, fish-eggs, frogs, angle-worms and small mollusks generally.

THE SOFT-SHELLED "TURTLE"¹ is perhaps the most common representative of this Family in the United States. It is found from South Carolina westward through the Gulf states to Texas; up the Mississippi to Indiana, Illinois and the Great Lakes, north and westward up the Missouri to the Rocky Mountains.

¹ *As-pi-do-nec'tes fe'rox*.

I never shall forget those I encountered in central Indiana, when fishing with hook and line. The provoking Soft-Shells would persist in swallowing hooks that were not baited for them, and the difficulties we had in cutting off their leathery heads and dissecting out our hooks tried our patience very sorely. It was not until many years later that we squared accounts with this species. At Miami, Florida, fine large specimens were fried in batter, and eaten with great relish. When properly cooked, the shell of this reptile is tender and desirable.

A large specimen has a shell 16 inches long by 14 inches wide, and weighs from 20 to 30 pounds. The upper surface is olive-brown mottled with black, and underneath is clear white. On account of its widely palmated feet, these "turtles" are the most active swimmers of all the fresh-water terrapins and turtles. In North America this Family is represented by five species.

THE SEA TURTLES

The sea is so vast, it is but natural that we should look to it for the largest species of Chelonians. There is one character by which any one can recognize a sea turtle, anywhere. The front limbs are developed as *long, flat, triangular flippers, without separate toes and claws, like the flippers of a sea-lion.*

Nearly all the sea-going Turtles are large, and one species is the largest of all living Chelonians. Without exception, all are habitants of tropical waters; but occasionally an individual is lulled into fancied security, and borne northward in

the warm waters of the Gulf Stream until it wanders out of the track, and suddenly finds itself in the chilly arctic current. Then, benumbed with cold, it falls an easy prey to the first predatory fisherman who sails near it, and promptly lands in Fulton Market.

HARD-SHELLED SEA TURTLES

Chelonidae

THE GREEN TURTLE¹ is the most important and valuable of the sea turtles, and in the Atlantic it is the species that is most widely distributed. It is of large size, its flesh is excellent food, and wherever found it is regarded as a prize. It is said that sometimes it attains a weight of about 600 pounds; but those which now find their way to market in our large cities are steadily diminishing in size, and rarely exceed 50 pounds.

This turtle is found from Long Island down the Atlantic to Cuba, throughout the Gulf of Mexico, the Caribbean Sea, the West Indies, and on southward to Brazil. It is also found in the Indian Ocean, and is common on the coast of Ceylon. I should say that on our coast Key West is its centre of greatest abundance and maximum size. The favorite haunts of this creature are in the shallow channels that lie between the keys, where they find quiet waters and plenty of food, but no security from the sharp eyes of the turtle-catchers. It feeds upon aquatic plants that grow on the bottom of shallow seas.

A large proportion of the Green Turtles captured on the

¹ *Che-lo'ne my'das.*

Florida coast are sent north, by steamer and rail, to supply the ever-greedy and high-priced city markets from Baltimore northward.

And really, it is not surprising that the flesh of this animal is considered most excellent food, and much sought after, both for soups and steaks. It is tender, fine-grained, dark-colored, not too fat and very agreeable in flavor. Moreover, this is a clean-looking animal, its shell is smooth, its head is small and neatly formed, and the front flippers are scaled quite down to their extremities. The shell is of no commercial value.

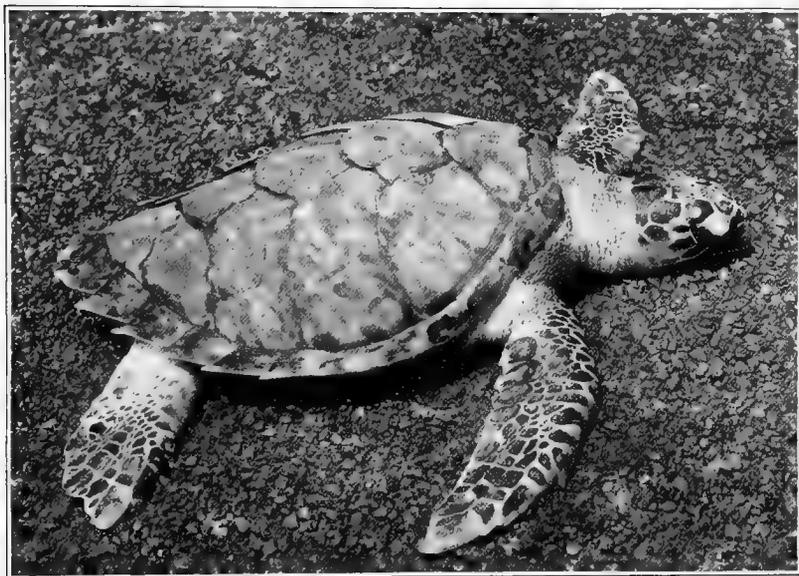
THE HAWKSBILL TURTLE, OR TORTOISE-SHELL TURTLE,¹ furnishes the valuable tortoise-shell of commerce, and it is the most beautiful of all the Chelonians. Its name is derived from the strongly hooked beak which terminates its upper jaw. Its back is covered with a roof of very beautiful curved plates of tortoise-shell, overlapping like shingles, each scale terminating in a saw-tooth point. The scales are clear yellowish horn, beautifully mottled with black and brown.

This species is yet found occasionally around the Bahama Islands, where the sea is very clear, and the white-sand bottom is liberally garnished with sea-fans, corals, and other beautiful invertebrate forms. Its range as a whole is from the coast of southern Florida, the Bahamas and the Gulf of Mexico, southward through the West Indies to the Amazon. It also inhabits the tropical waters of the Old World.

Formerly it often grew to a weight of between 20 and 30

¹ *Che-lo'ne im-bri-ca'ta.*

pounds, but it has been so persistently sought after, on account of the commercial value of its shell, that all those now seen in the markets are very small. The largest shell on record is 34 inches long. Another species is found on the Pacific coast, and it bears so strong a resemblance to its eastern



THE HAWKSBILL TURTLE, FURNISHING TORTOISE-SHELL.

relative that for a considerable period the two species were believed to be identical.

THE **LOGGERHEAD TURTLE**¹ looks like a coarse and large-headed understudy of the green turtle. It is readily distinguished, however, by its massive head, and thick, heavy shell. It is a turtle of coarser quality every way than the green turtle, and sells at a lower price. Like its handsomer

¹ *Thal-las-so-chel'ys car-et'ta.*

relative, it is widely distributed, but does not inhabit the Indian Ocean.

The flesh of this animal bears so close a resemblance to beefsteak that even a butcher cannot always detect the difference. One Christmas morning, at Key West, I dissected a large Loggerhead. The flesh was fresh, and very tempting, and when a choicèe lot of steaks were offered to the landlady of a certain small hotel, they were gratefully accepted.

It happened that the butcher who supplied the hotel with beef and mutton was a boarder thereat; and, as became his calling, he sat at the head of the long table, and served the meat. Although he was an able butcher, he had one weakness; and it lay in the fact he "could *not* eat turtle-meat." It was "too oily," too "musky," and too far removed from beefsteak.

With no unnecessary announcements, the turtle-steaks were fried, *à la* beefsteak, and set before the butcher. He served them as beefsteak, ate his own portion with evident relish, and all the other guests ate theirs. The butcher had nearly finished his second instalment, without having discovered the substitution, when he was asked how he liked turtle-steaks, for a change.

The sandy beach on the east coast of Florida, along the Indian River Peninsula, is a favorite spot for both Loggerhead and green turtles to lay their eggs. Mrs. C. F. Latham, of Oak Lodge, ninety miles above Palm Beach, has made careful observations on the habits of these turtles. In the months of May and June, when the summer heat is becoming severe, on moonlight nights the turtles crawl up out of



THE HARP TURTLE, OR LYRE TURTLE.

the water, dig holes in the sand high above tide-mark, from 15 to 18 inches deep, and in them lay their eggs, to the number of from 80 to 220. The period required for incubation is about sixty days. When first hatched the young are only $2\frac{1}{2}$ inches long, but the moment they emerge from the nest they start for the ocean.

LEATHERY-SHELLED SEA TURTLES

Dermochelydidae

THE HARP TURTLE, or LYRE TURTLE,¹ is the giant of the Chelonians of the present day. Sometimes it is called the LEATHER-BACKED TURTLE. I once dissected and preserved a specimen which weighed 740 pounds, and the oil and the toil of it are yet vividly remembered.

This remarkable creature has a very feeble bony shell, which is buried under a one-inch layer of fatty material which looks quite like the blubber of a whale. It is easily cut with a knife, and contains about a pint of oil for every square foot. The back of this strange creature is marked by five sharp ridges that run lengthwise, and are separated by concave, wave-like depressions. The front flippers are very long, and it seems quite certain that even in its native element this great animal is slow and clumsy. Its flesh is quite unfit for food.

This turtle is found very sparingly along the Atlantic coast from Long Island southward, but is abundant nowhere. One may travel all around Florida, and all through the West Indies without seeing even one specimen.

¹ *Sphar'gis co-ri-a'-ce-a.*

CHAPTER XLII

ORDER OF LIZARDS

LACERTILIA

OF all the world's reptiles, the lizards are the most elusive, and the most difficult to know personally. With the exception of the large iguanas, monitors and a very few others, the vast majority of the species are tiny creatures, lightning-quick in movement, and very much opposed to being caught.

And the little sprites are difficult to keep in captivity, beyond all other reptiles. Being children of the sun and sands, they demand quarters that are of desert dryness, roasting heat, and flooded with sunshine. Without these conditions they refuse to eat, and quickly die. If every student of lizards had a private desert which he could keep heated up to 100 degrees, a sun all his own to shine upon it sixteen hours a day, and meal-worms without limit, it would be quite possible to keep small lizards long enough to become well acquainted with them. Without such an equipment, the path of the student is beset with difficulties.

Because of these conditions, we will introduce here only a very few of what we may call the practicable lizards,—those which it is possible to know, and worth while to note.

GENERAL CHARACTER.—Most of the lizards are four-footed creatures, many have long, whip-like tails, and nearly all are covered with scales, mostly very fine. Sometimes the scales are large and horny. Quite a number of species are either partly or wholly covered with spines. The majority of lizards live upon the ground, or near the earth, but quite a number of species live in trees. Those called flying dragons



COMMON IGUANA.

possess parachute wings, and can fly as a flying squirrel does. Some of the legless lizards live in the earth.

Most lizards have teeth, but usually of a very simple character, setting in each jaw in a long and rather even row, like the teeth of a saw.

There are eighteen Families of lizards, provided with eighteen formidable names, and it is not possible to consider each one. For the present we will omit all references to the Families, and merely present a few examples which will illustrate the Order as a whole.

THE IGUANAS are among the largest and most interesting of the Lizards, being surpassed in size only by the *Monitors*. In their food habits they are omnivorous. Although feeding chiefly upon vegetable food, many species devour birds and

eggs with great avidity. In their habits they are partly tree-climbing and partly terrestrial. By reason of their saw-toothed backs they are so odd and showy they always attract attention. Were it necessary to select but one species to represent all the species of Lizards, that one should be the COMMON IGUANA¹ of the West Indies, Central and South America. It is from 4 to 5 feet in length, in color it is an irregular mixture of green, black and yellow, and it may be recognized at a glance by the row of long, slender, fringe-like scales which rise along the centre of its back. One good look at its extremely long and slender toes is enough to suggest the idea that it is a climbing animal. It makes its home in thick tree-tops, and feeds chiefly upon fruit and soft vegetation. I can testify that its flesh is palatable food, for in the hungry Orinoco country we ate it more than once.

Iguanas generally possess one good trait which is sufficient to forever endear them to zoological garden people. They are good-tempered animals, and never fight, no matter how many are placed in one cage, nor how many species of Iguanas are represented. Owing to the ease with which these creatures are captured, their price in New York is about \$2 each.

THE MARINE IGUANA,² or SEA-LIZARD, of the Galapagos Islands, is a creature of gregarious habits, which means the habit of flocking or assembling together in companies of noteworthy size. So far as we know, this is the only lizard which elects to assemble in companies of several hundred individuals. When Mr. R. J. Beck visited Narborough Is-

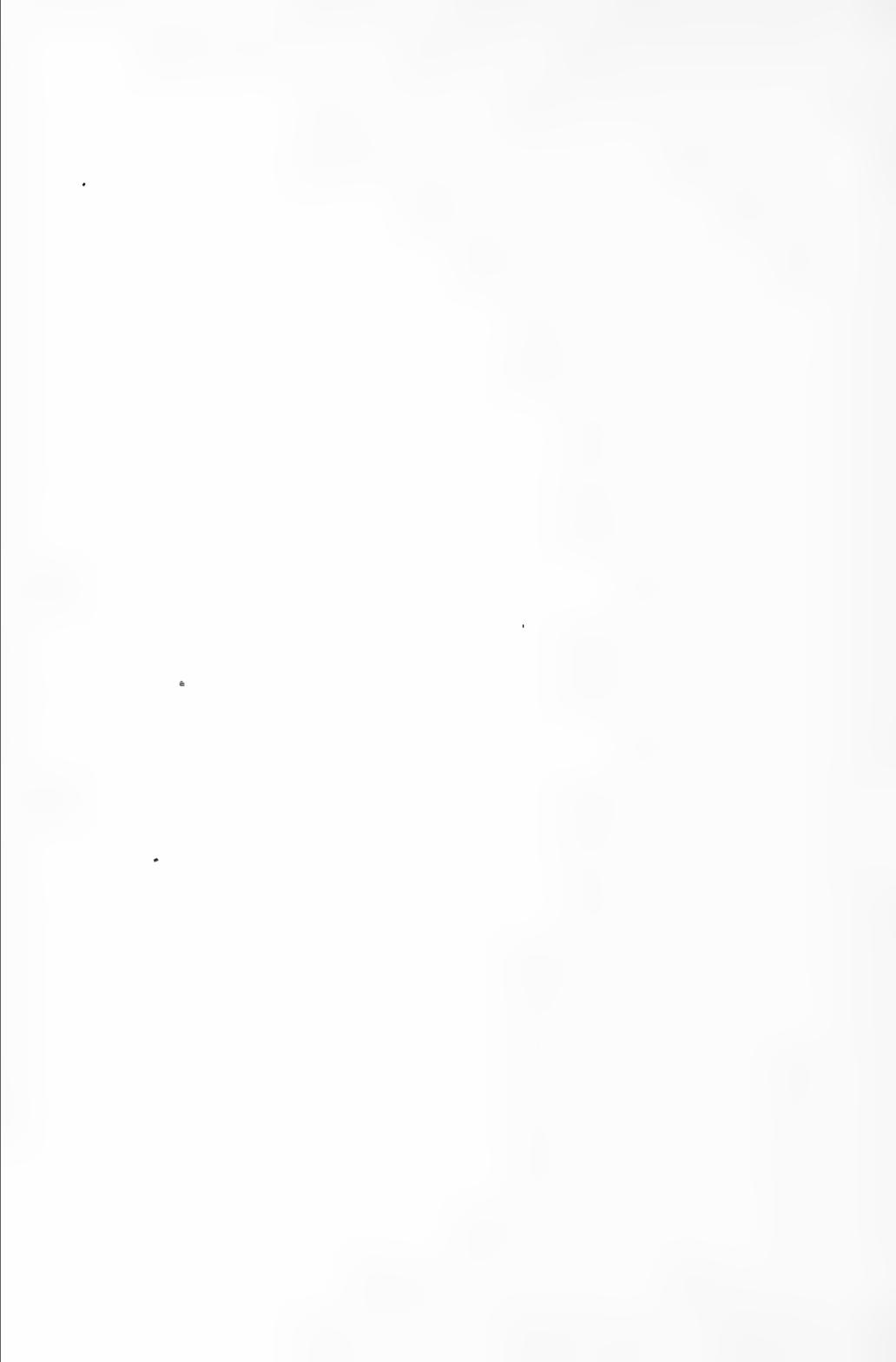
¹ *I-guan'a tu-ber-cu-la'ta.*

² *Am-bly-rhyn'chus cris-ta'tus.*



Photographed and copyrighted, 1903, by R. J. Beck.

MARINE IGUANAS ON NARBOROUGH ISLAND, GALAPAGOS ARCHIPELAGO.



land of the Galapagos group, in 1902, in quest of giant tortoises, he found on the clean lava-bed which formed the shore, a truly wonderful assemblage of Marine Iguanas. An area of at least three acres, destitute both of soil and vegetation, was literally covered by these reptiles, all wide-awake and fully interested in life, but serenely waiting for something to turn up.

Owing to their lymphatic temperament, and previous immunity from persecution by man, these strange creatures were quite tame, and willingly permitted Mr. Beck to make the photograph that is reproduced herewith. It represents one of the most wonderful views of reptilian life to be found anywhere on the earth to-day.

The Marine Iguana is a stockily built, dull-colored animal, about $4\frac{1}{2}$ feet in length, frugivorous in its habits, and very much at home in the water. It subsists almost wholly upon sea-weed.

THE RHINOCEROS IGUANA,¹ of the same form as the preceding, but much lighter in color, and marked by half a dozen horny tubercles on the upper surface of its head and snout, is found in Hayti and San Domingo.

Leaving the large lizards, of which be it remembered there are many interesting species in the Old World—called Monitors—impossible to mention here, we reach the small lizards, of which there are a legion of species. The warm and dry countries of the world literally swarm with these tiny creatures, which dart over rocks and fences like streaks of green or brown light. If you try to catch one by its long tail, and

¹ *Met-o-poc'e-ros cor-nu'tus.*

close upon it, the lizard leaves its tail between your thumb and finger, as a souvenir, and gayly streaks away *to grow another*, without loss of time! The power possessed by lizards to reproduce a missing tail is one of the strangest things in animal growth; but it is to be observed that the second

edition of a lizard's tail is far from being the shapely and perfect member that is seen in the first.



BLUE-TAILED LIZARD.

Many lizards, like much study, are a weariness to the flesh; and we will limit our exhibit to a very few prominent and interesting types which are well fitted to represent the entire group.

THE BLUE-TAILED LIZARD¹ is not only a common species throughout a wide area of the United States, but it is also representative of a large number of species which resemble it. It is found throughout the eastern half of the United States, from Nova Scotia and Canada to Florida and the Gulf, westward in the South to Arizona, and in the North to Wyoming. It is often called the SKINK, and "BLUE-TAIL," and BLUE-TAILED SKINK, and in summer it is available for study purposes to a larger number of school pupils than any other lizard known to the author.

The colors of this creature vary with age to an extent that is apt to be very confusing. Observe the programme:

¹ *Eu-me'ces quin-que-lin-e-at'us*.



In the N. Y. Zoological Park.

RHINOCEROS IGUANA.

During the first year the body is black, with bright yellow stripes, and the tail is brilliant blue. In the second the tail is slaty gray, and the black of the body is less intense. In the third the body becomes brownish, and the stripes are indistinct. In the fourth, and thereafter, the body is brown, the head vermilion and the stripes have disappeared. The length of a large specimen is about 8 inches.

All the small lizards and skinks are insect-eaters, and in captivity thrive best upon meal-worms and insects generally. Their quickness of movement is almost beyond belief, and even with a long-handled net it is very difficult to capture one alive and unhurt.

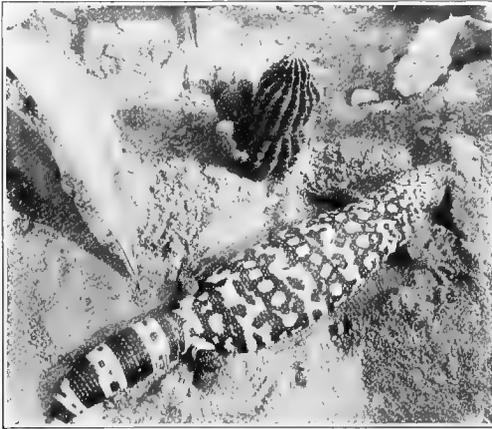
THE RING NECKED LIZARD,¹ which should be called the KANGAROO LIZARD, represents a group quite different from the skinks, and also nearer to the iguanas. It is a creature of the canyons, deserts and dry mountains of the Southwest, from Texas to southeastern California, and northward into Utah and Nevada. It is often found on mountains up to 5,000 and even 6,000 feet. (Merriam.)

This is a plump-bodied creature, and its colors vary to an extent that is apt to create confusion. It is either dark green or bluish above, and the sides, back and thighs are covered with light spots. The under surface is yellowish white, sometimes tinged with pale green. This lizard derives its name from two bands of black which stretch across the shoulders between the fore legs.

The most interesting feature about it appears never to have been observed and recorded until Mr. Barnum Brown

¹ *Cro-ta-phy'tus col-lar'is.*

sent several specimens to the Zoological Park. When one was liberated in a large sanded cage, it rose on its hind legs, in the position of an erect kangaroo, and in that strange posture ran rapidly. It held its head well erect, carried its fore legs *à la* kangaroo, and ran, not by hopping, but by taking long steps. In experimenting with the different indi-



GILA MONSTER.

viduals received from Mr. Brown, it was found that under similar provocation, all of them ran in the remarkable attitude described—highly suggestive of a pygmy dinosaur.

THE GILA MONSTER¹ is perhaps the most famous lizard of North America, and its first name is pronounced *He'la*.

It is big, odd-looking and very showy, and therefore is dear to the heart of nearly every collector of reptiles. A large specimen has a total length of 20 inches, girth around the middle, 9½ inches, and weighs 43 ounces. When in

¹ *Hel-o-der'ma sus-pec'tum*.

robust health, the body and tail seem stuffed to the point of discomfort. Externally the whole of the creature appears to be covered with round glass beads, jet black and orange-yellow in color, and laid on in a Navajo pattern.

This remarkable lizard inhabits the desert regions of Arizona and the adjoining state of Sonora, Mexico. It is more sluggish in its movements than a box tortoise, and the very slow and clumsy manner in which it partakes of its daily meal of raw eggs and chopped meat leads the observer to pity its helplessness. How it manages to secure a sufficient quantity of acceptable food on the deserts where it lives is a puzzle.

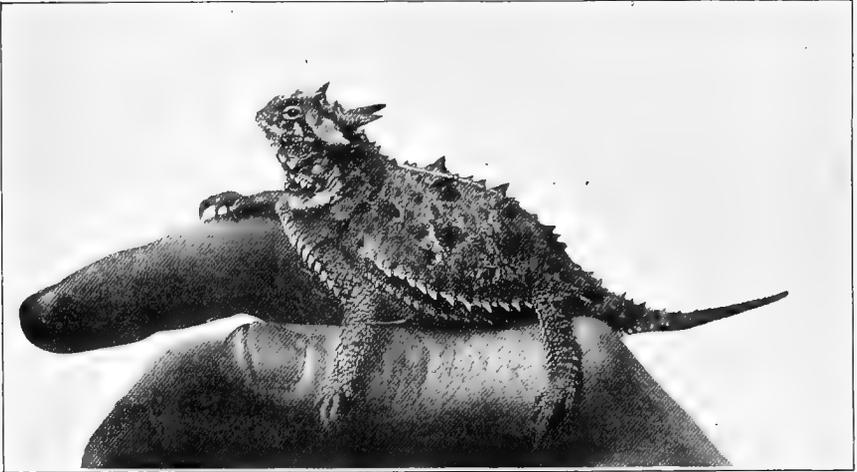
Whether the bite of this creature is poisonous or not is yet a debated question among naturalists. Several authorities cite the deaths of various small animals bitten by it, but others point to other victims which were bitten, but did not die. At the United States National Museum, Mr. A. Z. Schindler was bitten by a Gila Monster, but aside from a very natural degree of irritation and soreness of the wound during two or three days, he experienced no permanent ill effects from it. It is quite certain that the bite of this creature is seldom fatal to man, even if it ever is; but it can cause the death of small and weak creatures, like frogs and guinea-pigs.

This reptile lives well in captivity, and half a dozen of them in a desert cage make a very showy exhibit.

THE HORNED "TOAD,"¹ so dear to the heart of every eastern traveller on his first visit to the great Southwest,

¹ *Phry-no-so'ma cor-nu'tum.*

where deserts are plentiful and cheap, is not a "toad" at all. Observe its long *tail*, such as real toads never have, then call it forever after by its real name—**HORNED LIZARD**. There is much excuse, however, for the universal name; for,



HORNED LIZARD: DESERT HORNED "TOAD."

saving the presence of the tail, the little living cactus is quite toad-like in its form.

Professor Cope recognized eleven species of Horned Lizards, any one of which, wherever found, will serve as well as another to represent this genus. They are all habitants of the deserts and arid regions, where cacti, cat's claw, and other thorny things possess the land. They are frequently seen in the roads and trails of the Southwest, and are easily captured. If meal-worms are abundant, they are easily kept in captivity, on dry sand, in warm sunshine. The length of a large specimen is only $5\frac{1}{2}$ to 6 inches; and, strange

as it may seem, these odd creatures are related to the iguanas.

No! THE GLASS "SNAKE"¹ does *not* join itself together again after it has once been broken in two. And it is not



GLASS "SNAKE."

by any means a snake! It is a smooth-bodied, legless lizard, but so scaly and so snakelike in general appearance that any stranger is quite excusable for calling it a snake. As a matter of fact, the tail of this creature is so feebly attached to the body that a very moderate blow with a stick breaks the connection, and the reptile lies in two pieces. If left until doomsday, the severed parts will not reunite, but the body does its utmost to repair the injury by growing another tail. As a matter of fact, the new growth of tail is but a short and very imperfect substitute.

¹ *O-phi-o-sau'rus ven-tral'is.*

This creature inhabits the southern states from the Carolinas westward to Texas, and northward up the Mississippi Valley to Kansas and Wisconsin. It feeds chiefly upon insects, and being quite without legs, it forms an excellent connecting link between the lizards and serpents. There are quite a number of species of legless lizards.

CHAPTER XLIII

ORDER OF SERPENTS

GENERAL CHARACTERS.—A serpent, commonly called a “snake,” is a very slender, long-bodied, legless reptile, cold blooded, covered with scales, and breathing air. It moves by a sinuous motion, in which the scales under the body grip the earth, while the extension of the body muscles push the body forward. To afford a good hold upon the earth, the abdominal scales are very broad, set crosswise with the body and the rear edge of each scale is free and sharp like a blade.

THE BACKBONE contains a great number of vertebrae, sometimes nearly 300, and there is one for each crosswise scale under the body. There are also a great number of ribs, but the tail vertebrae are of course without them. The ribs are quite loosely attached to the vertebrae, in order that they may have the very free play that is absolutely necessary to the life of a serpent.

THE HEAD is usually flat and broad, and entirely covered with scales. The jaws are long, and well armed with long, sharp-pointed teeth, which point backward, in the direction of the throat. There are no molars for masticating food, and therefore all food is swallowed whole. Excepting in the injection of poison, the only function of the teeth is to seize

and hold fast the serpent's prey while it is being swallowed. Poisonous serpents have special teeth, called fangs, for making deep wounds and filling them with poison. These are set in the roof of the mouth, well forward, and while not in use they lie up against the roof of the mouth. The tongue of a serpent is very extensible, and capable of being thrust out fully half the length of the head. Its greatest use is in examining food, or possible food. From the fact that when travelling the tongue is so frequently thrust out, even when there is no excitement, it seems highly probable that it is used to detect vibrations in the air. (R. L. Ditmars.) The tongue is forked, and being entirely harmless, its sole use in defence is to threaten and intimidate its enemies.

THE LOWER JAWS are loosely attached to the skull, and to each other at their front end, by ligaments so elastic that when prey is being swallowed, the gape expands to enormous proportions. Mammals, birds and fishes to be swallowed are always seized head first, in order that the limbs, and also the feathers or scales, if there be any, will lie snugly against the body. Frogs and toads are usually taken hind feet first. The lower jaw is forced forward and over the animal, always one side at a time, as far as it will go; and when the teeth are inserted, that side is drawn back. The upper part of the head slides forward as far as possible, one side at a time, to match the lower jaw. Sometimes it seems as if the lower jaw will be torn loose from the head. Often after an animal has vanished, the jaws are a bad misfit, and do not come back into shape for half an hour.

The skin stretches like India-rubber, and over a heavy

meal the scales are widely separated. The manner in which serpents feed in a wild state is certainly one of the most cruel processes of Nature.

THE EYES of a serpent have no lids, and the eyes never close; but they are protected by a thin and perfectly transparent section of the outer skin, or epidermis, which is shed and renewed periodically.

THE EPIDERMIS, or outer skin, is completely renewed about three times per year. To free itself from the old skin, the serpent usually crawls through a small aperture, the edges of which catch the old skin at the head and hold it fast while the owner crawls out of it. The first intimation of an impending change of epidermis is found in the dull appearance of the eye, over which a glassy film seems to be forming. Strange to say, even the eye sheds its outer surface, and emerges clear and brilliant. Most snakes shed their skins about three times a year.

A serpent is always most beautiful immediately after it has shed its epidermis, for then its colors are brightest and most iridescent. In captivity it often happens that the atmosphere in which a snake lives is not sufficiently moist to enable the old skin to loosen and be cast off. In such cases, if the serpents are non-venomous species, the owner must moisten the old skin, and peel it off by hand, or with forceps.

REPRODUCTION.—Some snakes lay eggs, with soft, tough shells, that are hatched by the sun. A serpent which develops in an egg of this sort is provided with a special, temporary tooth, set on the tip end of its jaw, with which it easily punctures the shell sufficiently to escape. Others do

not develop eggs with shells, but instead retain their eggs in their own bodies until the young are fully developed. Finally, they are brought forth, each fully enclosed in a thin, membranous sac, which the little serpent quickly bursts. Snakes that lay eggs are called *o-vip'a-rous*, and those that bring forth their young alive are called *vi-vip'a-rous*.

Although serpents are cold-blooded animals, they reach their highest development in warm latitudes, and in regions of arctic cold they do not survive. In the temperate zone and the tropics, Nature has fitted them for life upon the ground, in the water and in the tree-tops; and they inhabit swamps, uplands and deserts. They live under stones and logs, in hollow trees and stumps, and in holes in the earth; they seldom attack man wilfully, and without provocation.

FOOD OF SERPENTS.—In a wild state snakes feed chiefly upon frogs and toads, fish, other snakes, small birds and mammals. Large serpents feed upon mammals of all sizes, up to small deer and goats. Water snakes feed chiefly upon fish and frogs. Land species find frogs, toads and small lizards their cheapest prey, but the extent to which snakes feed upon each other is quite surprising. For example, the king cobra,¹ a large, athletic, and very deadly land serpent of the Malay Peninsula, feeds exclusively upon other snakes and lizards, and while a greedy feeder upon what it prefers, it persistently refuses all other food. During the three years that one of these serpents has been kept in the Zoological Park, it has persistently refused to eat any of the moccasins or rattlesnakes which have been offered to it.

¹ *Na'ja bun-gar'us*.

This fine specimen, which is nearly 11 feet long, became, toward the end of its first winter, so difficult to provide for, when the special supply of food-snakes had become well-nigh exhausted, that Curator Ditmars and Keeper Snyder tried a novel experiment. They killed a 6-foot snake, stuffed it with frogs to the number of half a dozen, then offered it to the cobra. It was immediately accepted, and devoured in good faith; and since that time the experiment has often been repeated.

A large collection of captive reptiles requires many different kinds of food, and plenty of it. It is not necessary that food should be given alive. Very naturally, a serpent cannot swallow a bird or a mammal which is stiff in death, and unyielding. Swallowing is not possible unless the legs or wings are folded very closely against the body. All that a serpent requires is that the animal be offered while yet warm, and before *rigor mortis* has set in. The practice is to kill the food in the Reptile House, and offer it immediately afterward, while it is yet warm.

During the year 1914 the Reptile House contained 42 Crocodilians, 217 Lizards, 247 Chelonians, 339 Serpents and 241 Amphibians, making a total of 177 species and 1,086 specimens. The animal food consumed by our reptiles during the year 1902 was as follows:

3,550 Rats and Mice,	512 Guinea-Pigs,
1,456 English Sparrows,	About 18,000 Meal-Worms,
624 Small Chickens,	About 25,500 Live Fish,
208 Large Chickens,	About 2,000 Toads,
210 Pigeons,	About 2,000 Frogs,
1,300 Eggs,	About 2,500 lbs. Vegetables
272 Rabbits,	and Fruit.

CLASSIFICATION OF SERPENTS.—Unfortunately, it is impossible to offer the general student a diagram of the Families of living serpents, based on the highest scientific authorities, which would be either simple or understandable. The species are many, and their teeth, scales, bones and other features are diversified. Thus far no scientific authority has succeeded in dividing the world's serpents into logical groups without basing the divisions upon anatomical features, and describing them in technical terms which only the special student of reptiles can understand.

By way of example, take Professor Gadow's simple statement of the distinguishing characters of the Family *Colubridae*: "ectopterygoids are present: the squamosals are loosely attached to the skull, and carry the quadrates, which are not reached by the pterygoids: the prefrontals are not in contact with the nasals; the maxillaries are horizontal, and form the greater portion of the upper jaws: the mandibles lack the coronoid process or element: both jaws are toothed."

Under the circumstances, our wisest course will be to select and set forth a series of small groups of serpents which will introduce the species most worth knowing, and at the same time convey a fair amount of general information regarding serpents as a whole.

POPULAR QUESTIONS AND MISAPPREHENSIONS.—Regarding the habits of serpents there are many unsettled questions and many disputes. The perennial "Hoop-Snake" delusion, for example, will not down, and probably it never will lack exponents and defenders.

The question "Do snakes swallow their young?" is also

a perpetual storm-centre; and there is plenty of reliable evidence on all sides of it.

Snake disputes between truthful persons are due either to deceptions of the eye (*an organ easily deceived!*), a misinterpretation of things seen, or imperfect observations.

For example, men of the highest truthfulness have been deceived into the fixed belief that they have "*seen* horse-hairs turn into worms."

Without attempting to settle out of hand any of the snake disputes that are "rock-ribbed, and ancient as the sun," I will at least state what experienced men, who have observed and studied reptiles all their lives, and gathered facts regarding them, *believe to be true*.

The "Hoop Snake," which is said to travel by taking the end of its tail in its mouth, and rolling along like a hoop, is believed to be an absolute myth.

It is believed that snake mothers do *not* swallow their young in order to protect them, and emit them all as good as new when the danger is over.

Many snakes do hiss, some of them as loudly as a red-hot poker thrust into cold water.

The tongue of a snake is not capable of inflicting a wound, nor of conveying poison into the blood of another creature.

Snakes never are "slimy."

Removing the fangs of a poisonous serpent does not necessarily render it harmless; for new fangs promptly grow out to take the place of those removed.

The rattle of the rattlesnake contains more than one joint for each year of life—usually two or three.

*THE LARGEST SPECIES OF SERPENTS**Family Boidae*

The Family *Bo'i-dae*, containing the boas, anacondas and pythons, embraces between sixty and seventy species.

It is as natural for human interest in animals to be greatest toward those that are the largest of their kind, as it is for sparks to fly upward. It is well to see what Nature can do when she puts forth her best efforts. No one need apologize for a keen interest in pythons, boas and anacondas, provided that interest is kept down to bed-rock truth, and all exaggerations and overestimates are rigidly eliminated. Unfortunately, however, the makers of sensations about wild animals regard all large serpents as their lawful prey, and often stretch them unmercifully.

THE BOA CONSTRICTOR.—The serpents which seize their prey, and crush it into compact shape before swallowing it, are *constrictors*, because of their method; but all big serpents are not necessarily *Boa* constrictors. That title applies to but a single species, found in South America; and, curiously enough, its Latin name is also its popular name.

In seizing its prey, this serpent instantly reveals its name by its method. The jaws open widely, fly forward with electric quickness, close on the animal, and hold fast. Instantly thereafter, a coil of the body near the head is flung completely around the victim and drawn tight, to suppress struggling, and prevent possible escape from the jaws. From the oldest and largest to the youngest and smallest *Boa* Constrictors, all seize their prey with precisely the same action,

and the flinging of the first coil follows so quickly after the strike of the jaws that the two acts seem almost simultaneous.

The Boa Constrictor is much smaller than its neighbor, the anaconda, and not more than one-half the size of the gigantic reticulated python of the East Indies. Its maximum length is about 12 feet. It inhabits South America, from



BOA CONSTRICTOR.

the Caribbean Sea to Paraguay, but only in forested regions, where animal food is plentiful, and cover for concealment is abundant. This species is readily recognized by its bright, reddish-brown tail, which is much more highly colored than the head and body. It is also marked by the prevalence of reddish, iron-rust brown in its color scheme, and the very large oval patches of light color, divided by black bands, that are laid along its back with regularity and precision. The sides are beautifully marked by light-colored diamonds and bars.

When at home, this serpent feeds upon pacas, agoutis,

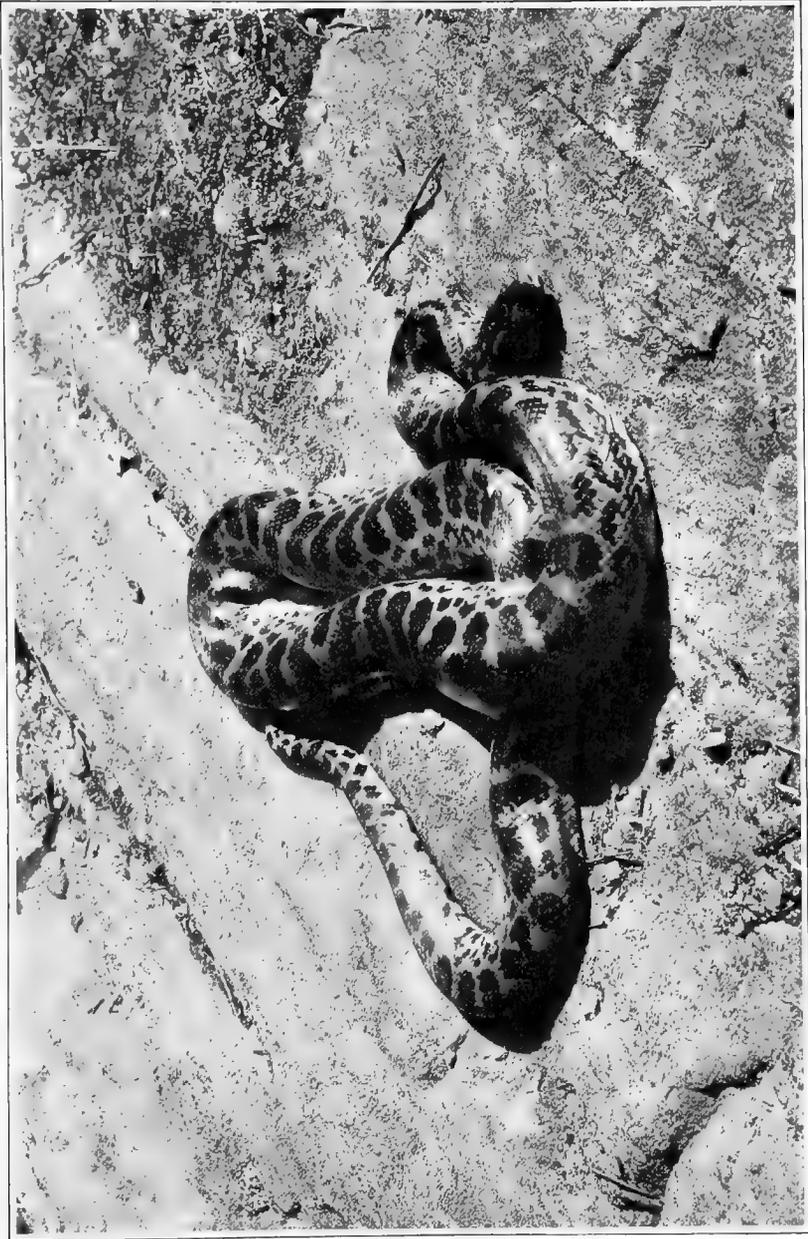
capybaras, tamanduas, young peccaries and tapirs, and any bird that is large enough to justify attention. Considering the excellent climbing powers of the Boa Constrictor, and the dulness of certain South American monkeys, it is highly probable that monkeys furnish many a meal for this serpent. The sloth is protected in two ways. It prefers the small and weak outer branches of a tree, and it moves so slowly and unostentatiously a Boa would be long in finding one.

If a 12-foot Boa once wrapped itself around an unarmed man, it undoubtedly could suffocate him or crush him to death, but it would be impossible for it to swallow him. There is at hand no authentic record of a Boa Constrictor ever having killed a man or a horse. In South America I was assured by native hunters that Boas and anacondas swallow antlered deer, but when direct proof of this was called for, it never came.

THE ANACONDA¹ is the great water-constrictor of South America, and it so loves the aqueous element that some captive specimens never leave their bathing-tanks unless forced to do so. This serpent is strongly marked for identification by the very large black spots, round or nearly so, which cover its back from head to tail, laid on a dark olive ground. Sometimes these are arranged in pairs, and suggest dumb-bells.

This species attains very great size, and being fully equal to the reticulated python of the East Indies, it is one of the largest of living serpents. Of course it can hardly happen that specimens of the largest size would find their way into zoological gardens. The largest thus far exhibited in the

¹ *Eu-nec'tes mu-ri'nus*.



YELLOW ANACONDA.
Eunectes notaeus.

Zoological Park measured 18 feet 6 inches, and came from the Berbice River, British Guiana. It is reported that in the British Museum there is a stuffed specimen which is 29 feet long.

In British Guiana I was assured by local hunters that the "Camudie," as this serpent is commonly called, often attains a length of 35 feet. There is, however, no proof that it exceeds 30 feet; and any traveller or observer who has the good fortune to meet with a specimen exceeding that length will do well to back up his tape measure with either the preserved skin or skeleton. One snake-skin is more convincing than a hundred snake-stories.

I believe the delta of the Orinoco is the northern limit of the Anaconda, where it is called the "Culebra de Agua," and regarded with profound respect. It inhabits the Guianas and Brazil, and probably extends to the headwaters of the Amazon, in eastern Peru. Of its regular food, the capybara (a water-loving rodent, as large as a good-sized hog) undoubtedly stands first, followed by the tapir, otter, deer and large water-birds generally.

THE RETICULATED PYTHON,¹ of the Malay Peninsula, Sumatra and Borneo, is the largest serpent of the Old World, and the only rival of the anaconda for first place. A surprisingly large number of specimens of this species are captured alive each year, and sold to dealers in wild animals. As a result, the largest serpent with which the animal-loving public becomes familiar in the zoological gardens and parks is this handsome Python. Specimens exceeding 20 feet in

¹ *Python re-tic-u-la'tus*.

length, and running up to 25 feet, occasionally come into the possession of the animal dealers of Singapore, but about three-fourths of them die from lack of proper care before they are finally disposed of in Europe or America, and placed on exhibition.

The largest specimen which thus far has died in the Zoological Park measured 22 feet 10 inches, and weighed 170 pounds. Mr. R. L. Ditmars ("Reptiles of the World," p. 219) regards the Reticulated Python as the largest of all living serpents, actually attaining a length of 30 feet. He states that a friend of his once measured a dead specimen that was only a few inches under 30 feet.

This splendid Python is at home in the hot and moist jungle which from Burmah to Java covers the land with a dense mantle of trees, thorny palms, rattans and tangled underbrush. Its colors consist of a network of yellows and yellowish browns and black laid over a ground of light brown, all beautifully harmonized. Immediately after the shedding of an old epidermis the scales have an iridescent metallic sheen that is very beautiful.

The temperature is practically stationary all the year round, and varies little save between 82° and 98° F. The frequent rains, and the moist, hot-house air of that region, with abundant animal food and ample cover, constitute ideal conditions for the rapid growth of reptiles, and the triennial shedding of their epidermis. It is no wonder that Pythons and king cobras grow large there, or that they are so numerous that many of the former are caught alive by the Malays.

But the term "numerous" is capable of several interpre-



RETICULATED PYTHON.

tations, and in this case we enjoin a strict limitation. Although between forty and fifty Pythons of two large species¹ leave Singapore every year, let it not for one moment be supposed that anywhere in the East Indies are these serpents so numerous that they constitute a danger to human life, or that it is even possible to find them by hunting for them. Quite the contrary.

I spent several months in the Far East, roaming through jungles of all kinds, some of them so dense and so full of deadly bogs and miasma that now I recall them with a shudder. I never once found a wild Python, great or small; nor a cobra, even in cobra-ridden Hindustan; nor did any of my own native followers ever find a specimen of either for me. The only wild Python I ever saw or handled in its home jungle was one that was brought to me in the Malay Peninsula. It was hiding in a hollow tree, and when it looked out at a Malay who was passing, he whipped out his parong, cut off its head at one blow, and came to me calmly dragging behind him twelve feet of dead snake.

So far as I could learn, even the largest Pythons are harmless to man. They sometimes visit native villages, crawl through the frail fences which very feebly protect the domestic animals, and swallow—chickens and ducks! It is in these humble raids that some Pythons come to grief by being caught alive. But jungle people have no fear that a Python would make such a blunder as to attempt to make a conquest of a man. To be sure, in the Far East, people do

¹ The Black-Tailed Python (*Python mo-lu'rus*), although smaller than the Reticulated, attains a length of 20 feet.

not often go poking around in the jungles at night in thick darkness. It is not considered the proper thing to do so.

The food of the Pythons of the East Indies must consist chiefly of the muntjac, hog-deer and other deer of small size; young wild pigs, pheasants and jungle-fowl. Our captive Pythons prefer pigs, and pigs of from 5 to 25 pounds' weight have now become their standard food. These are accepted with relish when no other food will be considered. A 25-pound pig is quite right for a 20-foot snake. A Python should voluntarily eat a full meal every two weeks.

Until quite recently it was generally believed that if a large serpent would not feed voluntarily there was nothing to be done for it save to watch it commit suicide by starvation. Twelve years ago Mr. Raymond L. Ditmars, Curator of Reptiles in the Zoological Park, determined upon a very bold experiment. He decided that a starving 20-foot Python should be fed artificially. Accordingly, a smooth bamboo pole was procured, and a string of four rabbits was tied up so that the pole would thrust the first one far into the serpent's interior, and drag the others after it. The next question was, how could the snake be controlled?

Summoning Keepers Snyder and Dahl, and five other men, the cage-door was opened. As the reptile raised its head to strike the intruders, a stream of cold water from a hose struck it full in the face. When it recoiled in confusion, the plucky keepers seized it by the neck, and quickly dragged it from its cage. As its form emerged, the waiting men seized it at proper intervals, and held it nearly straight.

The Curator presented the pole-strung rabbits, the first

of which was angrily seized in the Python's jaws. With this auspicious beginning, it was the work of only a few moments to gradually push the string of wet rabbits down the serpent's throat, to a distance of seven feet, and withdraw the pole. Finally, the tail and body of the snake were thrust into the cage, and with a careful toss from the hands of Mr. Snyder, the head landed on the coils, sufficiently distant that the door could be closed without accident.

Since that time the substitution of freshly killed pigs for rabbits, chickens and ducks has rendered forcible feeding unnecessary.

HARMLESS SNAKES OF THE UNITED STATES

Of the grand army of harmless snakes inhabiting North America, the KING SNAKE¹ is unquestionably the king. It is also called the CHAIN SNAKE and THUNDER SNAKE. It is the most courageous of all snakes, and in proportion to its size it is also the strongest. Toward man it is by no means especially vicious; but, on the contrary, its manner is quite tolerant.

Toward all other serpents, however, it manifests as great aversion as any snake-hating woman, and it is pugnacious and aggressive to an astonishing degree. The King Snake is, for its size, the most powerful of all the constrictors, and does not hesitate to attack a snake of another species several times larger than itself. It is cannibalistic in its tastes, and not only attacks and kills other snakes, but devours them.

In our Reptile House, a snake of this species once attacked

¹ *O-phi-bo'lus ge-tu'lus*.

a Cuban boa, fully three times its own size, and tried to swallow it! Had not the boa been rescued, it would undoubtedly have been quickly suffocated by the coils which its antagonist had wrapped tightly around its body. On another occasion a King Snake that was placed for a very short time in the cage of the water moccasins, attacked one of the



KING SNAKE.

latter, wrapped around it and killed it. Several times the moccasin bit its assailant, but the King Snake is immune to the venom of serpents, and paid no attention to the counter-attack.

In some portions of the South, the King Snake is believed to be a special enemy of rattlesnakes and moccasins, and on this account it is preserved from general slaughter. It is well attested that it does sometimes kill and devour snakes of both those species.

This bold serpent is found from Maryland to southern

Florida, thence westward through the Gulf states to Oklahoma, Texas and Matamoras, Mexico. Its average length is about $3\frac{1}{2}$ feet, and it rarely exceeds 4 feet. From Maryland to Georgia it is a black snake with thirty white bands or rings around it, and is called the Chain Snake. Farther south its body-color is greenish, with white rings, and is called the Thunder Snake. Its favorite food is rats, mice, lizards, birds, and other snakes; but no frogs are eaten.

It reproduces by laying eggs. In Texas, New Mexico, and Sonora, Mexico, the *Splendid King Snake* is found. In Arizona, California and Nevada occurs *Boyle's King Snake*, a conspicuous black serpent, marked by thirty broad, cream-colored bands. The latter sometimes predominate so effectively as to give the snake a general cream-colored appearance with black rings. An entirely black variety, without rings, is found in Indiana and Illinois.

THE CORN SNAKE,¹ sometimes called the RED RACER, is one of the handsomest serpents in North America. Its general color tone is mottled yellowish-red, or reddish-yellow. In detail its color-pattern consists of about forty squarish blocks along the back, each of which is dull brick-red, with a deep margin of black, outside of which is a lighter ground-color. Its length is a little over 3 feet, and its form is slender and graceful.

Like the king snake, this serpent is a powerful constrictor, a good climber, and seldom is seen on the ground. In the fields and forests, it is usually found in or upon low bushes. It frequents the habitations of man, and the roofs of old out-

¹ *Co-lu'ber gut-ta'tus.*

buildings are its favorite hunting-grounds for rats and mice. It is fond of rats, and because of this is considered a useful ally of the southern farmer, by whom it is often called the **RAT SNAKE**. (Raymond L. Ditmars.)

This serpent is courageous, but not particularly aggressive. Its food consists of rats, birds, eggs, small rodents and warm-blooded creatures generally. In South Carolina, Mr. Ditmars captured a specimen which but a few minutes previously had finished swallowing a bob-white.

The home of this interesting and beautiful serpent is practically the same as that of the king snake—along the Atlantic coast from Maryland to Florida, and westward through the Gulf states to Arkansas. This snake is an egg-layer.

THE **GOPHER SNAKE**¹ is our representative of the rat-snakes of South America and India, that make a business of catching rats in and around dwellings and out-buildings. In the South, it is often called the "**BLACK SNAKE**"—because it is black; but when it is particularly well polished, it takes on a gun-barrel blue appearance, when it is also called the **INDIGO SNAKE**.

This is a large and showy serpent, often attaining 8 feet in length, very docile and good-natured, and easily tamed.

At Oak Lodge, Florida, we once saw a very large wild Gopher Snake emerge from the saw-palmetto jungle, and crawl directly toward the house. When Mrs. Latham was informed, she cried out reassuringly, "Oh, that is my pet snake! It keeps the place clear of rats." Forthwith she

¹ *Spi-lo'tes co'ra-is cou'per-ii*.

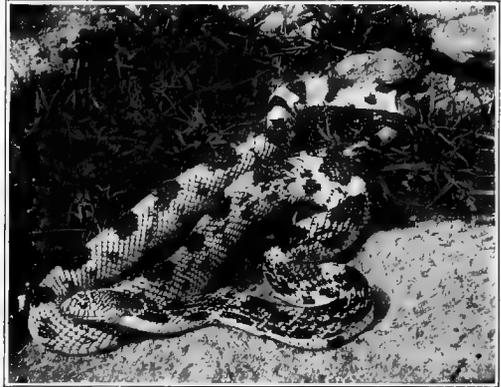
laid hold of it and picked it up, which the serpent did not resent in the least, even when it was passed from hand to hand for close examination. When finally released, it leisurely crawled under the house, quite as if nothing had happened.

This is one of the best of all serpents to keep in captivity. It is next in hardiness to the water moccasin. It is an omnivorous feeder, and, named in the order of choice, its food consists of rats, mice, birds, snakes, eggs, frogs, fish, lizards and even raw meat! (R. L. Ditmars.)

The Gopher Snake is not a constrictor, it does not climb frequently, and does not care for water except to drink. It is strictly a warm-country species, and inhabits our Gulf states, from Florida to Matamoras, Mexico.

The typical PINE SNAKE¹ inhabits the sandy pine woods along the Atlantic coast from New Jersey to Florida; but other species of this genus are found throughout nearly every other portion of the United States except New England.

This species is quite harmless, even to other snakes, but, for all that, it is a powerful constrictor. It lays eggs, and feeds upon birds, small rodents and eggs. In devouring eggs



PINE SNAKE.

¹ *Pit-y-o'phis me-lan-o-leu'cus.*

it has a very odd but intelligent trick. It swallows an egg whole, and after it has passed a few inches down the throat, where it forms a large swelling, the serpent lifts its head, elevates its back, and exerts downward pressure directly upon the egg until the shell breaks!

A striking peculiarity of the Pine Snake is found in the structure of its epiglottis, first observed and described by Dr. C. A. White, by means of which the hiss of this creature is so loud and so well sustained that it is like the hiss of red-hot iron in water. The maximum length of this snake is about $7\frac{1}{2}$ feet. Its ground-color is whitish, the head is spotted with black, and along the back there is a series of about twenty-four very large brown patches, margined with black. Sometimes these blotches of color take shape as bands. The abdomen is dull yellow, with blackish-brown patches.

THE BLACK SNAKE of the East is a serpent of narrow form, but wide distribution. Westward it changes color, and is known at first as the BLUE RACER, and then as the GREEN RACER. Although its Latin name is *Za-me'nis con-stric'tor*, it is not a constrictor, it is badly misnamed, it is perfectly harmless to man and its bite is never more than a mere scratch. It is very cowardly, and will leap wildly from the edge of a rock or a steep bank in order to escape. If cornered, it makes a fierce but often absurd fight, sometimes becoming so frantic that it bites its own body. (R. L. Ditmars.)

This snake is a good climber, swims well, and is active and quick in movement, but it has no real power to speak of. It is not an enemy of the rattlesnake, as many persons suppose, but it devours snakes that are smaller and weaker

than itself. Its favorite food consists of small rodents, young birds, eggs and frogs, but it does not eat fish. It is a great destroyer of mice and moles, and deserves well of the farmer on that account.

The young differ in color from adult specimens, being slaty gray, with chestnut-brown saddles on the back. In the



WESTERN COACH-WHIP SNAKE, OR RED RACER.

third year these colors fade, and the snake assumes its adult color. Speaking generally, the black form of this species occurs nearly everywhere throughout the United States east of the Mississippi into New England. What is called the *intermediate color* is too widely scattered to be defined, while the *green-and-yellow* form is found from Nebraska and Louisiana westward to the Pacific coast, and from Puget Sound to San Diego.

The length of this snake, when adult, varies from 40 to 58 inches.

THE COACH-WHIP SNAKE¹ is closely related to the preceding species (both being members of the same genus), and has similar habits. It is even more slender than the black snake. Its standard color is, toward the head, black or light yellowish-brown, fading out rapidly backward, until the tail becomes nearly white. But these colors vary exceedingly in widely separated localities.

This is a southern snake, and extends from Florida quite across the continent to California. In the far Southwest, its colors are so much suffused with pinkish it becomes the RED RACER (*Zamenis flagellum frenatum*).

THE GARTER SNAKE,² our oldest and most familiar friend among the snakes, is as harmless as a house-fly, and any one who exerts himself to crush one simply makes a pitiful exhibition of ignorance and folly. This is the most prolific and generally abundant snake in North America, and no amount of persecution seems to diminish its numbers to any noticeable degree. During the month of March, 1903, about 450 specimens were collected in and around the Zoological Park.

This serpent is viviparous, and sometimes forty-five are born in one brood. Out of a brood of thirty-eight born in our Reptile House, there was one double-headed specimen and three albinos. The standard length of this snake is from 24 to 30 inches, and one 36 inches long is a large specimen. Of the genus to which the Garter Snake belongs,

¹ *Za-me'nis fla-gel'lum.*

² *Eu-tae'ni-a sir-tal'is.*

twenty-four species have been described, covering the whole of the United States, and much contiguous territory. From the species named above, twelve tiresome subspecies have been evolved, which are of no interest whatever to the general student.

THE RED-BELLIED WATER SNAKE¹ is a highly colored variety of the common Water Snake that merits special attention. It is the most showy and handsome representative of an interesting group of water snakes, comprising about ten species, all of which are harmless, but very much in evidence in small streams and other bodies of water. They



COMMON GARTER SNAKE.

bring forth their young alive. They love to lie upon low bushes that overhang water, and bask in the sun. They are very suspicious, however, and when disturbed drop head first into the water, like a stream of oil running down. The way to catch them is with a wire noose on the end of a light pole about ten feet long.

The species named above is widely known amongst the negroes of the Carolinas and other portions of the South as the COPPER-BELLIED "MOCCASIN," and it is feared accordingly. To the negroes of South Carolina, all water snakes

¹ *Na'trix fas-ci-a'ta er-yth'ro-gas-ter.*

are "Moccasins." The Red-Bellied is held to be very deadly, and its bite is said to be "fatal" unless counteracted with large doses of good whiskey! (R. L. Ditmars.)

Water snakes feed chiefly upon small fishes and frogs. From the stomach of one Red-Bellied Water Snake collected in South Carolina, Mr. Ditmars took three sunfish, one cat-



N. Y. Zoological Park.

RED-BELLIED WATER SNAKE.

fish, about a dozen tiny suckers and a crawfish. This interesting fish collection had filled the serpent so full it could hold no more. The species referred to is prominently marked by its shiny red belly, and rusty-brown upper surface. It is from $3\frac{1}{2}$ to 4 feet long, and, like all Water Snakes, emits a disagreeable odor when handled. It inhabits the southern states generally, and extends northward into Illinois and Michigan.

THE COMMON WATER SNAKE¹ inhabits all of the Gulf states and the Mississippi Valley up to Iowa. In the New

¹ *Na'trix fas-ci-a'ta.*

England states as far up as Connecticut, and also in the southeastern states and the Mississippi Valley is found a subspecies called *Natrix fasciata sipedon*.

THE HOG-NOSED SNAKE¹ is a serpent of many names and remarkable habits. It is often called the BLOWING "VIPER," SPREADING "ADDER," and other combinations of "Viper" and "Adder," all erroneous. This is the snake that is such a bold bluffer, and often saves its life by pretending to be very fierce and dangerous. Instead of fleeing from an intruder, this creature comes straight forward, with savage determination, hissing and darting out its tongue, and pretend-



HOG-NOSED SNAKE.

ing to be a serious proposition. It looks as ugly and deadly as any real viper. It inflates the skin of its neck with air, and hisses until it can be heard 25 feet.

In spite of all this bluffing, however, the Hog-Nosed Snake is really a harmless creature. It strikes viciously, but always with its mouth closed! Mr. Ditmars says it is almost impossible to induce one of these snakes to bite. When greatly annoyed, or tickled on the back, it will turn over on its back, open its mouth, allow its tongue to hang out, and permit the experimenter to hang it over a stick, as if dead. If thrown

¹ *He-ter'o-don plat-y-rhi'nus*.

upon the ground on its back, it will slowly turn back again, take in its tongue, and crawl away.

When a small boy I once had a thrilling encounter on a bare prairie with one of these snakes, which sought to take refuge in its hole while I fought it off with my hat. At last the snake fled, and I blocked up the mouth of the hole. While I was ploughing the next round, the snake returned, and with its nose dug a new opening running diagonally down into the old one, and entered.

This snake is flat-headed and thick-bodied, and varies in length from 30 to 37 inches. Its colors are a mixture of brown, yellow and black, with no definite pattern, and are almost impossible to describe successfully. This species lays eggs, which are about $1\frac{1}{2}$ inches in length, covered with a thick, tough, flexible shell. When hatched, the young are from 7 to 8 inches long, and they hiss very soon after they emerge. The embryo serpent possesses an "egg-tooth," for cutting the shell of the egg, but it loosens and drops out within a day or two after the serpent is hatched.

THE POISONOUS SNAKES OF NORTH AMERICA

Fortunately for us, all save one of our species of poisonous serpents are so peculiarly marked it is possible for any intelligent person to know them all, and recognize their dangerous character in a moment. This knowledge once acquired, all the other snakes of North America cease to be objects of dread or terror, and become merely so many interesting specimens of natural history.

A bird's-eye view of our venomous serpents reveals the following assemblage:

VENOMOUS SERPENTS OF NORTH AMERICA. . .	{	Rattlesnakes, 11 species, Massasaugas, 3 species, Water Moccasin, Copperhead, Harlequin Snake, Sonoran Coral Snake.
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Out of the 95,000,000 people in the United States, probably not more than two die each year as the result of snakebites. The number of timid people who are frightened by harmless snakes, each year, must be about 1,000,000. Now, if all the latter could be so fully informed as to be free for all time from *groundless* fear, what a relief to suffering nerves it would be.

And why should any one remain in ignorance? In reality, there are only five types to learn, all the rattlesnakes and massasaugas being referable to one group by reason of the rattles and "buttons" on their tails.

Come, then! Let us address ourselves to the very simple task of learning from a book how to recognize the venomous serpents of North America, as readily as one recognizes the dogs and horses of our next-door neighbor. Excepting the water moccasin, they are all so plainly marked that all persons except those who are blind may know them; and there is no excuse for forgetting them. Instead of going into their anatomy at length, our efforts for this occasion will be concentrated upon their external characters, habits and homes.

Fortunately, we have not in North America any househaunting serpents of great cunning and unflinching deadliness

like the HOODED COBRA, or COBRA-DE-CAPELLO,¹ of India. The bite of this species is very deadly, and whether wholly guilty or not, in India it is debited annually with the deaths of between 18,000 and 22,000 persons. It is said, however, that many persons are murdered on the sly, and their deaths are charged up to the account of the Cobra-de-Capello.

The reasons why so many persons are bitten by Cobras are: (1) that in the rainy season the serpents take refuge in and about the huts; (2) that practically all the natives go bare-footed and bare-legged; (3) that many of them are compelled to go about at night, without lights of any kind, and (4) the warning of the Cobra—spreading the hood and hissing—is more frequently given after the bite than before it! Moreover, the Cobra is naturally much more irritable and vicious than the rattlesnake or any other American serpent.

Of all the serpents that have entered the Reptile House, the Hooded Cobras are the most vicious and eager to do mischief. At the slightest excuse they spring to an erect posture, spread their hoods, and try their utmost to bite. One of them struck the glass of its cage front so frequently that it brought on a disease of the jawbone, which finally rendered it necessary to remove one entire side of the lower jaw. To keep the three Cobras from seriously injuring their heads by striking against the glass, it is necessary to keep the lower portion of the plate painted white.

The Hooded Cobra is a slender-bodied, nervous and active serpent, with a maximum length of about 48 inches. When

¹ *Na'ja tri-pu'di-ans.*



HOODED COBRA.

the rainy season is on in India, it seeks refuge in and about human dwellings, especially under floors, and is also partial to thatched roofs. For its bite there is no sure antidote.

THE KING COBRA, or SNAKE-EATING COBRA,¹ of the Malay Peninsula is the largest of all venomous serpents, easily attaining a length of 10 feet. It is a very athletic serpent, slender-bodied and strong-muscled, able to erect its head 3 feet, perpendicularly, and strike nearly a yard. It is a very expert and vigorous climber, swims nearly as well as a water snake, and is a thorough believer in the survival of the fittest. It feeds only upon other serpents and lizards, but it would be better if harmless serpents fed upon it.

No matter where you find him, the RATTLESNAKE is a fair fighter, and entitled to far more respect than he is likely to receive in this snake-terrified world. He strikes only in self-defence, when he thinks he is about to be trodden upon. Instead of lying in ambush, and striking in deadly silence, like the cobra and the moccasin, he rattles loudly when man or beast approaches, and gives fair warning to "keep off!" He rattles to save himself from injury, and his persistent *whir* has saved thousands of persons, and tens of thousands of domestic animals, from being bitten. A western cow-pony, a government mule, or a range steer will spring sideways from a warning whir in the sage-brush quite as quickly as a man himself, and almost as far.

If Rattlesnakes generally (of which there are fifteen species) were disposed to be mean, and treat man as many human beings treat all serpents, the annual death list from Rattlesnake bites would be a long one. Despite the few exceptional cases, however, it is a ruling fact that Rattlesnakes do not go pestering around camps, or frequently crawl under

¹ *Na'ja bun-gar'us*.

the blankets of men sleeping upon the ground. Every year thousands of cow-boys sleep on the ground, literally among these reptiles, without a single Rattlesnake accident.

Thanks to a long-standing acquaintance with this serpent, I have myself on numberless occasions "bedded down in the open" in Montana, Wyoming, Florida and elsewhere, with not a moment's fear of snakes. Depend upon it, a Rattlesnake does not go about looking for trouble. His best efforts are devoted to the promotion of peace and longevity.

Beyond question, the Rattler is a serpent of timid and retiring disposition. It has not one-half the courage of the hog-nosed snake, nor a quarter of the cobra's vicious aggressiveness. If you encounter one at a fair distance, say 10 feet, it will either crawl away, slowly and defensively, or coil and warn you to keep off. In its feeding habits, in captivity, it is one of the most timid and nervous of all reptiles, and seldom eats save when safe from observation and interruption. When darkness falls, and the Reptile House is entirely quiet, the Rattler bashfully swallows his freshly killed rat or guinea-pig.

My first experiment with a captive Rattlesnake, a huge Diamond Rattler from Florida, was to catch and place in its cage a live rat. The rat ran over the snake several times, and greatly annoyed it. The snake endeavored to get away from its disreputable associate, but in vain.

At last the rat flew at the Rattler, and bit him severely on the lips! This was too much to be endured. In a great rage the snake drew back, seized the body of the rat in its wide jaws, and *held on* while it drove its fangs through the

tough skin of the rodent, and far into its body. After one could have counted ten, the rat was released; and thirteen minutes later it was dead.

SPECIES OF RATTLESNAKES

Fourteen valid species of Rattlesnakes are found in North America, one in South America, and there are none elsewhere. Our most prominent species are as follows:

ENGLISH NAME	LOCALITY	LATIN NAME
DOG-FACED RATTLESNAKE	New Mexico	<i>Crotalus molossus</i> .
TIMBER RATTLESNAKE	Eastern half of United States	<i>Crotalus horridus</i> .
DIAMOND RATTLESNAKE	Florida and Gulf States	<i>Crotalus adamanteus</i> .
TEXAS RATTLESNAKE	The Southwest	<i>Crotalus atrox</i> .
PRAIRIE RATTLESNAKE	The Plains Region	<i>Crotalus confluentus</i> .
PACIFIC RATTLESNAKE	The Pacific States	<i>Crotalus lucifer</i> .
TIGER RATTLESNAKE	Extreme Southwest	<i>Crotalus tigris</i> .
HORNED RATTLESNAKE	Extreme Southwest	<i>Crotalus cerastes</i> .
GREEN RATTLESNAKE	Mexican Boundary	<i>Crotalus lepidus</i> .
WHITE RATTLESNAKE	Southern and Lower California	<i>Crotalus mitchelli</i> .
MASSASAUGA	Nebraska to New York	<i>Sistrurus catenatus</i> .
EDWARDS' MASSASAUGA	The Southwest	<i>Sistrurus edwardsi</i> .
GROUND RATTLESNAKE	Atlantic States South	<i>Sistrurus miliarius</i> .

Among the Rattlesnake species are several striking examples of color-development to suit their surroundings, or what is known in well-worn phrase as "protective coloration." The Banded or Timber Rattlesnake is a good imitation of the color of dead leaves and damp earth. The color pattern of the Diamond Rattler is made up of rich though quiet tones of brown and yellow, dark and light, like the shadows of saw-palmetto leaves falling upon yellow sand. The Texas Rattler and the Horned Rattlesnake of the Southwest are so

pale and bleached one instantly associates them with naked deserts shimmering in fierce sunshine.

In their habits, so far as known, the various species are very much alike. They bring forth their young alive, the normal number being between nine and fourteen. As soon as an infant Rattler bursts the thin transparent sac in which it is born, it is ready to coil and strike. Even at birth it is fully equipped with poison and fangs. Wild or captive, the favorite food of a full-grown Rattler is small mammals; but what they feed upon in a wild state, when very young, remains to be ascertained. From our six species of captives, we have learned that Rattlers climb bushes with almost as much ease as professional tree-climbers, but in a wild state it seems fairly certain that they rarely do so.

The tail of the Rattlesnake is ornamented at the end with a rattle consisting of a number of joints of horny material developed out of the skin, one section dovetailed into another. The exact age of a Rattler is not indicated by the number of joints in the rattle at the rate of one for each year. On the contrary, under favorable circumstances about three joints will be developed each year, until the snake reaches maturity. We have now, in the Reptile House, Rattlesnakes three years old which already have in their rattles from seven to nine joints.

The rattles are not shed when an old skin is cast off, nor are they ever shed; but they are frequently broken off, usually about three joints each year after more than nine or ten joints have been acquired. It is very seldom that more than ten joints are found on a living snake.

It is possible to lengthen a snake's rattles, after they have been cut off, by joining on other joints of the same size, up to the number desired. The slow vibration of a large set of rattles gives a sort of clicking sound, but when the wearer is thoroughly alarmed and angry, the spiteful "whir" sounds



N. Y. Zoological Park.

DIAMOND RATTLESNAKE.

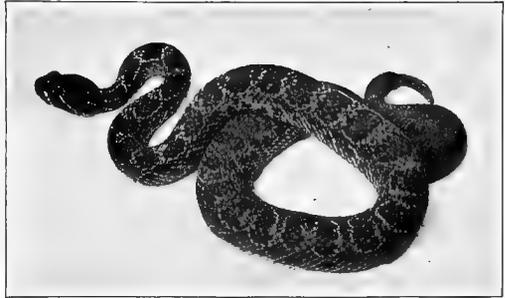
like meat frying. The motion then is so rapid the eye cannot follow it.

Rattlers are not fond of bathing, but when swimming is necessary they swim well. The species which live in the North pass the cold months in burrows below the frost line, either in the earth or among rocks. If the situation chosen proves to be a cold one, the serpent becomes so torpid that it seems lifeless.

I once found a Prairie Rattlesnake abroad in northern Montana on October 10, two weeks after the first fall of snow. When brought to a realizing sense of its weakness and unworthiness, it crawled into a hole like a shallow post

hole, and lay on the bottom completely exposed. This species is very wise in sheltering in the burrows of the prairie-“dog,” but where none of those are to be found, the wash-out holes in cut banks can always be relied upon to furnish warm shelter for Rattler, bob-cat or wolf.

THE DIAMOND RATTLESNAKE¹ is a royal serpent, the largest of the rattlers, and the handsomest snake in North America. A specimen 6 feet long, in good condition, will be accepted anywhere as a large one, but the largest specimens far exceed that size. At Oak Lodge, Florida, in the possession of Mrs. C.



PRAIRIE RATTLESNAKE.

F. Latham, I saw the skin of the largest individual ever known to me. The wearer measured, before it was skinned, 8 feet 5 inches, and its girth at the thickest part of its body was 1 foot 3 inches.

This brown-and-gold species is most at home in Florida, on clean sand, among the cabbage-palmettos, saw-palmettos, and long-leafed pines. Although it rarely takes to water, it is sometimes called the WATER RATTLER. It ranges northward into the Carolinas, westward through the Gulf states to the Mississippi River, and probably beyond. In Texas begins the home of the big TEXAS RATTLESNAKE,² of the same size and appearance as the Diamond, color pattern and

¹ *Cro'ta-lus ad-a-man'te-us.*

² *Cro'ta-lus a'trox.*



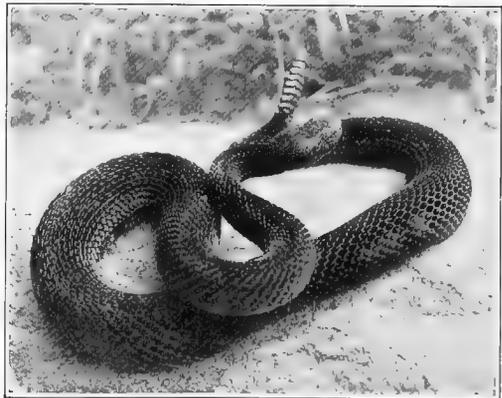
BANDED RATTLESNAKE. (YELLOW PHASE.)

all, but of a very light color, as becomes a serpent of the arid regions.

In captivity the Diamond Rattler is, like all members of its genus, a timid and erratic feeder. Unless

all conditions are entirely to its liking—perfect quietness, choice food and no one looking, it will not swallow a morsel. When its views on the subject of food and service have been fully met, it will partake of a young rabbit, a rat or a guinea-pig.

THE TIMBER, or BANDED, RATTLESNAKE¹ of the eastern United States shows a wide range in color, varying from a handsome sulphur yellow to brown, and finally to almost black. Young specimens are always lighter in color than old ones. One of the popular names of this creature is derived from the broad bands of brown color which encircle the light-colored specimens. Often the hinder half of an adult or old specimen has a black-velvet appearance. The length of a large specimen is $4\frac{1}{2}$ feet.



BANDED RATTLESNAKE. (DARK PHASE.)

¹ *Cro'ta-lus hor'ri-dus*.

This Rattlesnake has suffered more from civilization than any other species. Throughout many vast areas of rich and



HORNED RATTLESNAKE: "SIDEWINDER."

closely cultivated agricultural regions, it is now totally extinct. Although it is believed to exist within fifty miles of New York City, a living specimen would be about as difficult to find as a mastodon.

Not so! Several specimens were taken in the mountains of New Mexico in 1880.

Originally the home of this species embraced the entire territory from the Atlantic coast to western Iowa, Kansas, and into Texas. In many portions of this region it still exists in small numbers, and is said to be "fairly common in the Allegheny Mountains," from Pennsylvania southward.

THE HORNED RATTLESNAKE, or SIDE-WINDER,¹ of the Far Southwest is a creature of the deserts, and the oddest member of this group. It has a small horn over each eye, and in crawling it moves sidewise, in very deep curves, totally different from the straightforward course of most rattlesnakes when on the war-path. This is the smallest of our rattlers. Its general color is yellowish gray, marked by small round spots, and its home is in southern Arizona, California, Nevada and probably Sonora, Mexico.

THE BUSHMASTER,² a viper which is also known as the MAPEPIRE and SIROCUCU, is the reptilian terror of the land that it inhabits—tropical South America, extending northward into Central America. It is the largest, the most showy, and apparently the most deadly of the poisonous serpents of the western hemisphere. Its maximum length is said to be 12 feet, but it is rather slender, and lacks the gross thickness of the cotton-mouth moccasin and the diamond rattler of our Gulf coast. Its colors are so striking as to render this serpent easily recognizable. Its pinkish-yellow ground-color is ornamented on the upper surface with large, open diamonds of black or dark brown that form a continuous chain from neck to tail. The tail is really black, marked by narrow bands of the light ground-color. The scales of this snake

¹ *Cro'ta-lus ce-ras'tes*.

² *La-che'sis mu'tus*.



THE BUSHMASTER. (*Lachesis mutus*.)

A very deadly viperine snake of South America which attains a length of from 9 to 12 feet.

rise from the body in such a manner that its surface is quite rough.

In Demerara the native hunters told me of this serpent with bated breath; and no wonder. Its bite is so deadly that a man bitten in the thigh died in 8 minutes! (R. L. Ditmars.)

About eight or ten specimens of this fearsome serpent have reached the Zoological Park, usually from the island of Trinidad, not one of which ever consented to take food. A captive Bushmaster simply refuses food until it dies, which usually occurs in three or four months. From this serpent the poison is extracted and used in the preparation of a homeopathic remedy in the ratio of about one in one million.

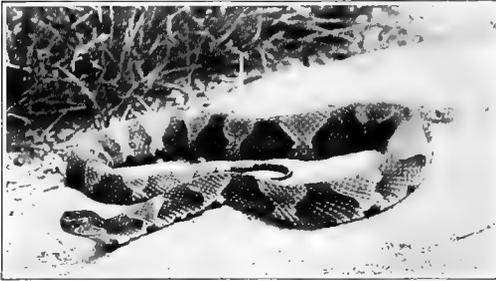


MASSASAUGA.

THE MASSASAUGA¹ is the type of a genus of rattlesnakes containing only three species, distinguished by various anatomical characters, but from neck to tail well marked, for the general student, by a succession of very dark-brown saddle-bag patches of color laid upon lighter brown. The joints of the rattles never exceed ten in number. This species is found at long intervals from the swamps of western New York to Nebraska, but it is so rare that living specimens are difficult to obtain.

¹ *Sistrurus catenatus*.

THE COPPERHEAD¹ is a rather short and small serpent, seldom exceeding three feet in length. Its colors look like two shades of copper—broad bands of old copper laid on a background of new copper. When the skin is new and fresh, or when a specimen has been reared in the shadows of captivity, this serpent is beautiful. Strangely enough, it is in



COPPERHEAD.

some respects the direct opposite of its nearest relative, the water moccasin.

The Copperhead is a serpent of the woods and rocks, and is not found in open grass lands. It is found

from Indiana eastward (but not northward) to the Atlantic coast, and well up into New England. It ranges southwestward to Texas, and in different portions of its home it is known as the *Pilot-Snake*, *Upland "Moccasin"* and *Deaf "Adder."* It is decidedly poisonous, and its venom is second in virulence only to that of the rattlesnake.

In captivity, the food of this species consists of small mammals, young birds and frogs. It brings forth its young alive, and the usual number is between 7 and 9.

THE WATER MOCCASIN, or COTTON-MOUTH,² is the ugliest snake in North America. Its body is about as lithe and graceful as a Bologna sausage, and its skin resembles the surface of sun-cracked mud. It is so ugly that stuffing it with

¹ *An-cis'tro-don con-tor'trix.*

² *An-cis'tro-don pis-ci-vo'ras.*



WATER MOCCASIN AND YOUNG.

tow does not make it look any worse. It has a piggish appetite for fish, but if no fish or frogs are handy, it eats other snakes. It is quite as ready to bite a friend as an enemy, and when Mr. Percy Selous was bitten by his "pet" Moccasin, he died in fifty hours, despite medical treatment.

The Moccasin is a southern snake, and it is a pity the species is not confined to Tierra del Fuego. It lives along the grassy margins of bayous and swamps, and is most frequently found lying at the shore line, with its head and a small portion of its body out of the water. It is also much in the habit of lying upon logs, on bushes overhanging water, or in the vicinity of dried-up pools. When disturbed, it starts up, opens its mouth very wide, holds it open, moves its tail in slow vibrations, and stares wickedly at the intruder. It is the whiteness of the interior of the mouth that has given rise to the name of "Cotton-Mouth Moccasin."

This serpent does not coil itself in a round, tight coil, like a rattlesnake. As a rule, it holds its ground tenaciously, and does not retreat unless deep water is near. The fangs are shorter in proportion than in the rattlesnake, and the action of the poison is not so quick and violent as that of the rattler. But the bite must be taken seriously, and treated with the utmost vigor, if a fatal result is to be avoided.

This serpent attains an extreme length of about 5 feet, and a diameter of 3 inches. Usually, however, specimens are about $3\frac{1}{2}$ feet by 2 inches. When adult, it is a snake *absolutely devoid of bright colors*, its scales being the color of dried mud, and very rough. The head is flat, the body thick and puffed out, and the tail is very blunt.

The young of the Moccasins are born alive, each one being enclosed in a thin, transparent sac, which bursts immediately upon reaching the outer air. The young are usually from 7 to 8 in number, but the last family born in the Reptile House contained 14. The young are strongly marked by light and dark bands, on account of which they are easily mistaken for young copperheads. They also resemble young hog-nosed snakes.

About the only redeeming feature in this serpent is the fact that in captivity it is very hardy. During four years we maintained a large collection in our Reptile House without the loss of even the poorest specimen. It is a serpent of the Gulf states, coming as far north as North Carolina and southern Illinois, and extending westward to Texas.

THE HARLEQUIN SNAKE¹ is a small, shiny, delicately formed serpent, of rather quiet habits and retiring disposition. It belongs to the same Family (*Elapidae*) as the deadly king-cobra of India! As far as it can be seen, it is instantly recognizable by the alternation of brilliant coral-red, yellow, and jet-black rings which encircle its body from head to tail-tip. Unlike the broad-headed pit vipers,² the head of this serpent is no wider than its neck, and as a special feature its head is quite insignificant in size, but is always crossed by a broad yellow band. It is well to remember from this species that *not all venomous serpents have lance-shaped heads*.

The range of this beautiful but rather stupid little serpent begins in South Carolina, and includes all the Gulf States

¹ *E'laps ful'vi-us*.

² So called because of the existence of a round and deep pit on the side of the head, about half-way between the eye and the end of the nose. In the rattle-snakes this character is very noticeable.

southward and westward to the Pecos River in Texas. It ascends the Mississippi states to southern Indiana. It is a very persistent ground-dweller, and in captivity it spends three-fourths of its time buried in the sand of its cage, quite out of sight. It eats garter snakes and black snakes voraciously. Although its bite is undoubtedly poisonous, I have



FER-DE-LANCE: LANCE-HEAD SNAKE.

never known of any one having been bitten. In fact, it is difficult to see how any one can be bitten by this serpent without having it done by special appointment.

THE SONORAN CORAL SNAKE,¹ of southern Arizona and northern Mexico, is in appearance much like the harlequin snake, and it is mentioned only because it is so little known, and to remark that it is a good subject for observation.

THE FER-DE-LANCE, or LANCE-HEAD SNAKE,² is the serpent terror of the West Indies. It is a small snake, only

¹ *E'laps eu-ryx-an'thus*.

² *Bo'throps lan-ce-o-la'tus*.

about 6 feet in length when fully grown, and 2 inches in diameter. Its head is very wide, and it has very long fangs in proportion to its size. Its color pattern strongly suggests the light phase of the timber rattlesnake—brown, with black markings. On two occasions that we know of, travellers returning from the West Indies have brought with them in pasteboard boxes, as indifferently as if they were frogs, living and healthy specimens of this venomous creature! One specimen was brought to us by a lady and her child, for identification; and the keepers of reptiles shudder even yet when they think what might easily have occurred.

Fortunately, this serpent is not particularly aggressive, or hostile toward those about it. When it seizes its prey, however, it buries its fangs, and holds on determinedly. A female specimen in our collection gave birth to twenty-four young, but they one and all refused to eat, and failed to survive.

SNAKE POISONS AND THEIR TREATMENT

The Rattlesnake's defensive equipment of fangs and poison has been perfected by Nature with as much care as the horns of hoofed animals, or the defensive armor of an armadillo. The ordinary jaw teeth have nothing to do with the poisoning process, and wounds from them would prove fatal only under exceptional conditions.

The venom of a serpent is a rather thick fluid, secreted in two glands that are situated on the side of the upper jaw, under the skin, behind the eye. In the stomach of an animal it is supposed to be harmless, and we know that in many cases it is so. To produce death, it must be injected into

the blood, by a method that is practically instantaneous, and very effective. First there must be a puncture, then the injection of the poison.

To pierce the skin and flesh, the rattlesnake has two special teeth, called *fangs*, which are very long, slender, slightly curved, and exceedingly sharp at the point. A slender tube traverses the axis of the fang, from the root almost to the point, for the passage of the venom. Around each fang is a flexible sheath of tough, white skin, evidently for its protection.

The fang of a diamond-backed rattlesnake—the largest species—is about an inch in length. The small bone in which it is set at the root (maxillary) is so hinged by tough ligaments attaching to the roof of the mouth that it has some freedom of motion. When the jaws are closed, the fangs lie against the roof of the mouth. When the serpent strikes an enemy with the intention of poisoning it, the mouth is opened widely, the pterygoid bone pushes hard against the maxillary, and the sheathed fangs are thrown forward until they look like great hooks of white skin.

A serpent cannot be rendered permanently harmless by the removal of its fangs, because the fangs are *constantly renewed*. Each operating fang is backed up by a series of smaller ones, of different sizes, growing and awaiting their turn to do duty, and drop away. An adult fang is shed every six or eight weeks. The old tooth does not drop out until the new one is close beside it, duly connected with the poison gland, and ready for duty. Then the old fang either drops out, or is left sticking in the next animal bitten.

Even if fangs were pulled out, the poison sac would remain, and a scratch from the jaw teeth, duly poisoned, would endanger the life of the patient.

In striking to do mischief, the function of the lower jaw is to get under the part to be bitten, and press it up firmly against the attack of the fangs. The mechanism by which the fangs are thrown forward consists of a series of levers, and the special student will be greatly interested in the published drawings which illustrate its details. It is admirably shown in "Amphibia and Reptilia," by Dr. H. Gadow.

EFFECT OF THE POISON.—It is obviously impossible in a work of this nature to enter into this subject at length. In lieu of this, we will offer a very brief digest of what we believe to be absolute facts. These have been gleaned with care from several sources, but I make special acknowledgment to Dr. Leonhard Stejneger's presentation of the subject in his admirable monograph on "The Poisonous Snakes of North America."¹

There are two ways for the introduction of snake-poison into the system of a warm-blooded animal: (1) *through the blood*, by direct connection with a vein or artery, and (2) *through the skin and muscles*, one or both.

Although some of the great investigators differ somewhat on this point, it now seems reasonably certain that the manner in which snake poison acts is by *paralyzing* the circulation of the blood, the breathing organs, the nerves, and even the digestive organs. The effect on the blood is a decrease

¹ Government Publication. For sale by the Bureau of Public Documents, Washington, D. C.

in the strength and rapidity of the flow. In the nerves (after the first period of excitement), drowsiness ensues, which in fatal cases often lasts until death. The breathing is gradually diminished in strength and volume. The brain is usually the last organ to succumb. Dr. Stejneger's conclusion is that "the death which follows the introduction of the venom into the circulation must be attributed to gastro-intestinal apoplexy, and the stupefying action exercised directly upon the nervous system."

Venom introduced directly into the blood acts with great rapidity. When introduced hypodermically, through the skin and muscles, its action is much slower, and if the case is treated with great vigor from the very start, the patient has a fair chance to recover. Except from cobra bites, very many do recover.

The most dangerous snake bites are those inflicted upon the neck or face. The least dangerous are those upon the feet, the legs below the knees, and the hands and forearms.

TREATMENT.—There is small need to apologize for recording here the fundamental principles that should be carried out in case of accident. In the first place, any one who expects to campaign in a country infested with poisonous snakes should expend \$5.00 in the purchase of a small pocket-case containing a hypodermic syringe, a bottle of chromic acid 1 to 100, and another of liquid strychnine. Only the boldest and most enterprising travellers ever get beyond the sphere of influence of whiskey and brandy.

During the last ten years, medical men have been conducting investigations and making experiments to produce a

universal antidote for snake poisons. These efforts have produced the now celebrated antivenomous serum, discovered by Dr. Calmette, of the Pasteur Institute of Lille, France. It is obtained by very gradually injecting cobra venom into the flesh of a living domestic animal, and giving Nature time to counteract the poison by her own methods. Eventually the subject becomes immune to these injections, and produces within itself a product which when injected into other animals renders them immune.

This material, now popularly known as antivenine, is prepared in large quantities, and sent all over the civilized world for use against animal poisons generally.

Aside from the use of the antitoxin referred to, the keynotes of the treatment of a snake-bitten patient are, bleeding the wound, isolation of the bitten part if it be possible, the application of an antidote, and stimulation. In case of an accident, the regular medical treatment appears to be about as follows:

1. Cut across the wound, or stab it, and compel it to bleed freely.

2. Tie a ligature, of cloth, rope, or string, around the bitten member, above the wound, to keep back, as long as possible, the poisoned blood from the veins of the body.

3. If antivenomous serum is at hand, inject it according to the directions which accompany it.

4. Give any alcoholic stimulant that may be available, in *small doses*, at frequent intervals; but remember that a *quantity* of any strong stimulant will do more harm than good, and may actually hasten complete paralysis and death.

Ammonia is of very little use, if any; and its use depends so much upon conditions that it should be employed only by a physician.

5. If the serum is not available, inject directly into the wound, as quickly as possible after the accident, a solution of chromic acid or permanganate of potash, 1 to 100, and see to it that the hypodermic needle penetrates to the bottom of each wound. In the absence of a syringe, bathe the wound with the solution.

6. Having done all possible at the wound itself, then give hypodermic injections, on leg or arm, of "15 to 20 minims of *liquid strychnine*, every 20 minutes, until slight tetanic spasms appear." (Stejneger.)

7. The ligature must be loosened from time to time, to permit a limited circulation of fresh blood, or mortification will ensue.

8. If medical aid is within reach, it should be procured as speedily as possible, but in most cases, the life of the patient depends upon what is done for him during the first hour following the accident.

MR. GRUBER'S TREATMENT.—A practical method by which to escape death from the bite of a rattlesnake can be learned of Mr. Peter Gruber, of Rochester, New York, who has been bitten about twenty times. His method of treating himself was described to the writer as follows:

"I no longer suck the venom from a wound. Unless a man's mouth is in very perfect condition it is dangerous. My first act is to take my knife and cut a slit an inch and a half long straight from my body into the wound, and continue

it the same distance beyond; and I make these two cuts bleed freely. This is to make the poisoned blood flow out of my veins, instead of farther into them, to poison my whole system. After the wound has bled as much as I think it should, I inject the permanganate above and around the wound. The proper proportion is one five-grain tablet of permanganate of potash dissolved in two ounces of water, and I inject about thirty minims—the capacity of a hypodermic syringe—about three times around and above the wound. I always have it ready, and I bathe the wound with this solution, using absorbent cotton to cover the wound so that it is not exposed to the air.

“During this time I take two or three small doses of whiskey—but not much. After the permanganate has had a chance to take effect, I bathe the wound freely with a solution of two ounces of laudanum and two ounces of Goulard’s extract in two quarts of water, and keep it moist with this until all unnatural colors leave it. And I drink quantities of milk—all I can swallow. After a time my stomach ejects it, and at first it comes up the color of snake venom. But I continue to take milk, again and again, until I am sure my stomach has been washed free from the poison. If the action of my heart grows weak, I inject strychnine into my arms with a hypodermic syringe.”

Mr. Gruber bears on his forearms and hands a number of scars, as ocular proof of the success of his method in the treatment of rattlesnake bites.

AMPHIBIANS

A BIRD'S-EYE VIEW OF THE CLASS AMPHIBIA

ORDER ECAUDATA:

THE TAILLESS AMPHIBIANS: FROGS AND TOADS

FAMILIES		TYPICAL SPECIES	
WATER FROGS	<i>Ra'ni-dae</i>	{ COMMON FROG }	<i>Rana clamata</i> .
		{ BULL FROG }	
TREE FROGS	<i>Hy'li-dae</i>	{ WOOD FROG }	<i>Rana catesbiana</i> .
		{ TREE FROG }	
TOADS	<i>Bu-fon'i-dae</i>	{ AMERICAN TOAD }	<i>Bufo lentiginosus</i> .
BURROWING TOADS	<i>Pel-o-bat'i-dae</i>	{ SPADE-FOOT TOAD }	<i>Scaphiopus holbrookii</i> .
		{ TOAD }	

ORDER URODELA:

TAILED AMPHIBIANS

SALAMANDERS	{ <i>Sal-a-man'dri-dae</i> }	{ AXOLOTL }	{ <i>Amblystoma mavor-tium</i> .
		{ SPOTTED SAL-AMANDER }	
		{ NEWT }	
AMPHIUMAS	<i>Am-phi-u'midae</i>	{ HELLBENDER }	{ <i>Cryptobranchus (Me-nopoma) alleghani-ensis</i> .
		{ CONGO "SNAKE" }	
MUD-PUPPIES	<i>Pro-te'i-dae</i>	{ MENOBRAN-CHUS OR MUD-PUPPY }	{ <i>Necturus maculatus</i> .
SIRENS	<i>Si-ren'i-dae</i>	MUD "EEL"	<i>Siren lacertina</i> .

ORDER APODA:

LEGLESS AND WORM-LIKE AMPHIBIANS

CAECILIANS	<i>Coe-ci-li'i-dae</i>	{ <i>Tytilonectes compres-sicauda</i> .
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CHAPTER XLIV

INTRODUCTION TO THE CLASS OF AMPHIBIANS

AMONG the many wonders of Nature, few are more interesting to the thoughtful mind than those forms which connect the great groups of vertebrate animals by bridging over what otherwise would seem like impassable chasms.

For example, between the classes of Mammals and Birds we have the platypus, or duck-bill, an Australian mammal the size of a small muskrat, which has webbed feet and a duck-like bill, and which reproduces by laying eggs. Between the classes of Birds and Reptiles there is a fossil bird called the *Archaeopteryx*, with a long, vertebrated, lizard-like tail, covered with feathers. The *Hesperornis* was a water-bird with teeth, but no wings, which inhabited the shores of a great western lake which now is a vast stretch of arid bad lands.

Between the Reptiles and the Fishes stretches a wonderful chain of living links by means of which those two Classes are united. So numerous are these forms, they make an independent Class, containing about 1,040 species. Originally this group was called *Batrachia*, but recently the fact has been recognized that that term is too limited in its appli-

cation, and by the latest authorities the term *Am-phen'i-a* has been adopted instead.

In the transition from the water-habiting Fishes, with gills and fins, to the land-going Reptiles, with lungs and legs, Nature has made some strange combinations. In some instances fins, legs, lungs and gills have become so mixed that several notable misfits have resulted. In some cases we see legs going with gills, and in others fins and lungs are associated. Many of the Amphibians will serve teachers as very striking object lessons in the evolution of animal forms.

The CLASS AMPHIBIA contains the cold-blooded vertebrates known as frogs, toads, salamanders, newts, proteans and sirens.

In the insect world we are familiar with the three stages of existence by which the larva passes into the chrysalis stage, and later on emerges as a perfect insect. Here, among the vertebrates, we find creatures which also pass through two very distinct and sharply defined stages.

An AMPHIBIAN, if literally translated from the Greek, is a creature of "two lives." A typical amphibian begins life as a legless, fish-like creature, possessed of perfect gills, an eel-like tail, and living wholly in water. This is the *larval stage* of the animal. Later on, four legs make their appearance, the tail disappears by absorption into the body, the digestive organs change from simple to complex form and lungs take the place of gills. In this *adult stage* the creature (usually) is fitted for life on land if it so elects.

Owing to the bewildering variations of form and anatomy that are exhibited by various species, it is almost impossible

to formulate a general statement regarding amphibians which will not be open to exceptions. If the reader will bear this in mind, we may venture to state the leading characters of the members of this Class.

GENERAL CHARACTERS.—All save a very few amphibians are hatched from soft, translucent, jelly-like eggs that are laid in shallow water, usually in stringy masses. Sometimes the larval stage of a species is passed in the egg, but usually this period forms an important part of the active life of the animal, and may be observed at length before the change to the adult stage takes place. Amphibians are (usually) covered with smooth skins, quite destitute of scales, and have minute teeth, or none at all. During the larval stage they feed chiefly upon vegetable food, but when adult the majority require animal food. Their skeletons are much more simple in structure than those of reptiles. The majority are aquatic. Some species permanently retain their gills, and live wholly in water; others, like the frogs and toads, lose their gills, acquire practical lungs and legs, and live upon land at will. Of the 1,040 species of amphibians, only forty are without legs.

An *amphibious* animal is not necessarily an amphibian. The hippopotamus, the seal, sea-lion, otter and crocodile are indeed very much at home in water, but they are far above the Class *Amphibia*. They are by no means creatures of two lives, and they do not pass through a larval stage before attaining perfect form.

Like the reptiles, the amphibians are confined to the torrid and temperate zones, but a surprising number of species

permanently inhabit some very cold and inhospitable portions of the temperate zone. With but very few exceptions the amphibians are quite useless to man. The legs of certain large species of frogs are prized by epicures, but, with this exception, civilized man regards amphibians generally as inedible. Scientifically, the Class is highly interesting, chiefly by reason of the striking changes which so many of its members undergo. As subjects for the classroom and laboratory, frogs and toads are of well-nigh universal availability. Unfortunately, however, too many courses in elementary zoology do not forge beyond the frog.

As usual in seeking an acquaintance with Nature, a very simple diagram places this Class of animals on a clear and comprehensible basis.

CHAPTER XLV

ORDER OF FROGS AND TOADS

ECAUDATA

THE members of this Order are the most numerous, most widely dispersed and the best known of the amphibians. In all there are about 900 species; and it may be added that the habits of some of them are very strange and interesting.

In their modes of life the frogs and toads exhibit great diversity of inclination. The tree frogs live in trees, the toads seldom leave dry land, the burrowing toads burrow in the earth, and the water frogs live in water at least half the time.

Some of these creatures begin active life in water, as ugly, little fish-like tadpoles, and their transformation into the perfect frogs may easily be watched from beginning to end. In some of the toads, however, the tadpole stage is passed *in the egg*, and at hatching-time a fully developed but very minute toad emerges, and begins to hop about. Others again develop from the tadpole stage, much the same as frogs.

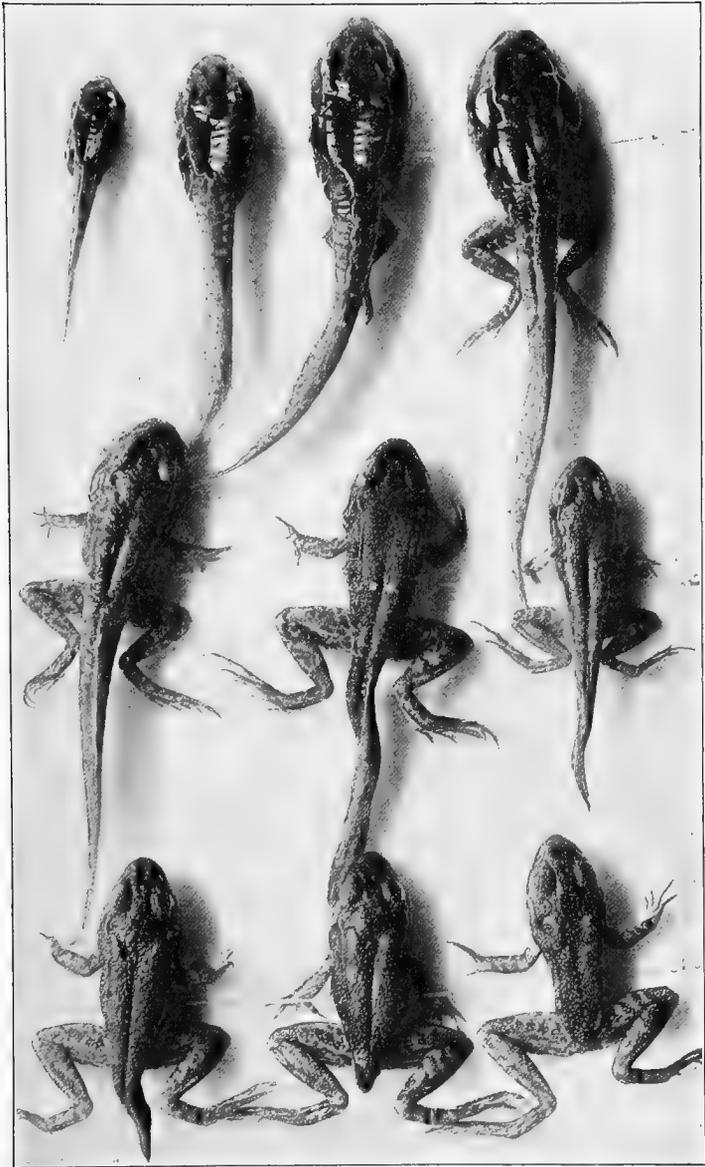
The larva of a species fairly typical of this Order as a whole may be found in the tadpole of any aquatic frog. It possesses a big, purse-like head—like that of a goose-fish—and a long eel-like tail, surrounded by a continuous fin. At first there is no sign of legs. The intestinal canal is very long and simple, as befits the vegetable diet of the creature. In the transformation process, the tail is absorbed into the body,

and long before it has disappeared two pairs of legs have grown out. The front legs are weak, but the hind legs are long and powerful, and being attached at the extreme end of the body they have great freedom of movement. They are adapted both for leaping and swimming.

Of the adult creature, the body is short and broad, covered with a smooth skin, destitute of scales, and there is no tail whatever. The mouth is wide and capacious. The tongue is not free, being attached at the sides to the lower jaw. The eyes are placed high up, quite above the upper surface of the head, so that the creature can float with only its eyes and nostrils above water.

The frog skeleton possesses several marked peculiarities, some of which must be noted, even though briefly. There are *no ribs*. The vertebrae are very few in number, but very wide in comparison with those of other vertebrates. The pelvis is of great size, and so long that it forms nearly one-half of the axis of the body. Instead of being attached at its sides, midway from top to bottom, the thigh bones (femora) are attached at the extreme lower end—the portion called the is'chi-um. In comparison with other vertebrates, the hind limbs and feet are of enormous proportions; and when these members are flexed, and then suddenly straightened out, the frog flies forward through the air as if thrown by a powerful steel spring. Some frogs can leap eight feet.

Although there are no ribs, there is a well-developed breast-bone, or sternum, for the attachment of the fore legs; and it is said that in the frog the sternum appears for the first time in the development of the vertebrates from the lower forms.



FROM TADPOLE TO FROG.

A series of specimens showing the development of the Common Frog.
Prepared by Raymond L. Ditmars and Charles Snyder.

The members of some groups of the frogs and toads have teeth in the upper jaw, on a bone called the *vomer*; others have teeth in both jaws, but the majority are toothless.

The hibernation habits of these creatures sometimes produce unexpected and remarkable results. Occasionally the public is startled by the publication of a story of a living frog



LEOPARD FROG.

Ra'na vi-res'cens.

or toad being dug out of solid rock, many feet below the surface of the earth. I have never had an opportunity to investigate any of these alleged occurrences, but a personal experience has at least furnished food for thought.

In a hot and dry jungle in the interior of Ceylon, I once made a search for elephant bones in the dry bed of what in wet weather was a shallow brook. The larger bones were

found upon the surface, but so many of the smaller ones had become embedded in the sand that it was necessary to dig for them. The sand had become so hard and solid it was half-way toward sandstone, and our spades and mattocks loosened it with difficulty.

About eighteen inches below the surface we came upon several small frogs, three species in all, closely and solidly entombed. Even the ignorant and stolid coolies were amazed and excited by the discovery. The sides of the animals were greatly distended by water, but from the first moment they were in full possession of their faculties.

As we released these creatures from their tombs and placed them upon the grass, each one disgorged a quantity of water, and hopped away. Evidently they had filled themselves with water and burrowed into the sand during the previous monsoon, then six months past, in order to live until the next rainy season; and had the annual water supply of that little stream been permanently diverted, no one can say how many years these frogs would have continued to live in their solid tomb of sand. The natives said that excepting in their wells, there was no water anywhere for many miles around.

THE FAMILY OF WATER FROGS

Ranidae

THE COMMON FROG¹ is the most popular and well-known species in North America. It is the first to be heard in spring, it gathers in the most numerous companies, and is one of the most cheerful and industrious croakers we know. Sometimes its cry becomes almost a warble; and when about

¹ *Ra'na cla-ma'ta.*

fifty voices are raised in tuneful chorus from the surface of one small pond, each one trilling and piping at the rate of sixty to the minute, without missing a note, the effort is certain to attract attention, in case there is any to be bestowed.

This species is one of the handsomest of our water frogs, and is colored to match its marshy home. Its upper ground-color is a brilliant green, broken up by irregular black blotches that are bordered with dull white, with dark bars across the legs. The head-and-body length is about 2½ inches.

THE BULL FROG¹ is known by its deep-bass voice and its great size when adult. Beside the preceding species, this creature is a giant, and it is small wonder that the eyes of epicures rest covetously upon its massive thighs. Its upper color varies from bright green to dark olive-brown, marked with small and rather inconspicuous dark spots. Its length varies from 5 to 8 inches, and it is so well known that further description is unnecessary.

As an indication of the extent to which frogs' legs are consumed as food in the United States, the following statistics of the United States Fish Commission are interesting. In 1899 the total quantity of frog meat recorded in the markets was 472,415 pounds, valued at \$74,690. The following were the chief sources of the supply:

	POUNDS	WORTH
Missouri.....	237,608	\$29,313
Arkansas.....	79,760	10,162
California.....	20,687	20,638

In 1895 New York handled 69,774 pounds, valued at \$6,572.

¹ *Ra'na cates-bi-an'a.*

THE WOOD FROG¹ is not often found without specially seeking it. In the spring, when you are searching for early flowers, and are startled by seeing a small dead leaf suddenly take life and leap about four feet, you may know that it is one of these small creatures. It is only 1½ inches long, being next in smallness to the tree frog. Although for a frog so small it can leap a very long distance, its strength is soon exhausted, and its final capture is easily made.

THE TREE FROG FAMILY

Hylidae

If tree frogs were of great rarity, and inhabited only one remote island of a far-distant archipelago, their climbing habits would be accounted as much of a wonder as the flight of the flying frog of Borneo. Being fairly abundant in the eastern United States, the tree frogs are regarded with but a mild degree of interest.

These creatures, which vary in length from 1 inch to 5 inches, have been provided with an opposable thumb, and a very effective sucking disk on the end of each toe, by which they are able to climb trees, and live very comfortably upon their branches. Of all vertebrates that live in trees, these tiny frogs are the most difficult to see. Even when one is chirping boldly and cheerfully within six feet of your eyes, it is necessary to look keenly in order to locate it. There are few kinds of rough bark with which the colors of a tree frog do not combine with startling accuracy. The opposable thumb, which appears in frogs and tree toads for the first time

¹ *Ra'na syl-vat'i-ca.*

in Nature's ascending scale, is of great use, and in all probability it is the principal factor in the arboreal life of these animals.

In South America there are several species of tree frogs whose females carry their eggs, during incubation, in pouches or cells *upon their backs*. It is believed that the eggs are



NORTHERN TREE FROG.

Natural size. Photographed at the instant of croaking, and copyright, 1903, by W. Lyman Underwood.

placed in position and embedded there by the male frogs. Other species attach their eggs to leaves that are afterward rolled together at the edges. Others deposit their eggs at the bases of large leaves where water collects, and some are credited with placing them where they will fall into pools, to be hatched there. A Brazilian species called the "SMITH"¹ constructs, at the edge of a pool, a really wonderful circular wall or fortress, of mud, in which its eggs are deposited.

¹ *Hy'la fa'ber*.

THE NORTHERN TREE FROG¹ is our best and most common representative of this large Family. It is 2 inches in length, and in cloudy weather, especially when storms are gathering, its cheerful, bird-like call is universally regarded as a harbinger of rain. It is not a high climber, seldom ascending more than 20 feet from the ground. Its colors match tree-bark so closely it requires very sharp eyes to find it, and when seen it usually is believed to be a knot.

In croaking, its vocal sac swells to enormous proportions. Mr. W. Lyman Underwood has been successful in photographing this animal at the instant of utterance, and his very interesting picture is reproduced herewith.

THE TOAD FAMILY

*Bufo*nidae

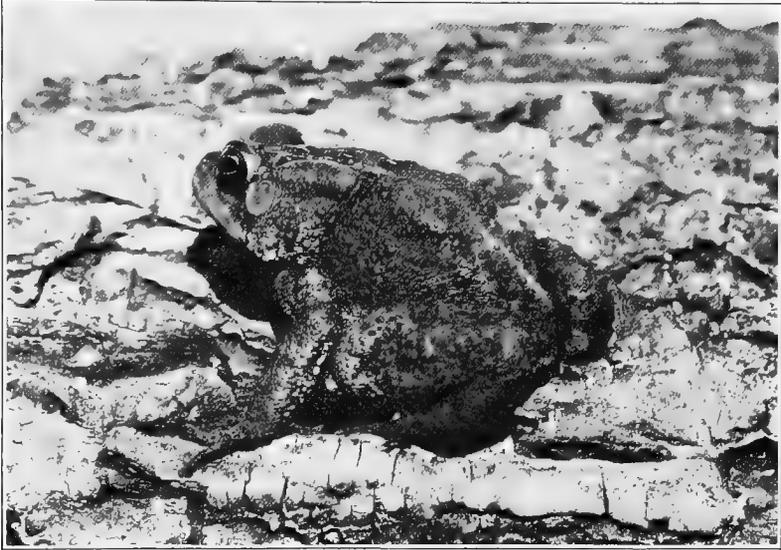
North American toads are distinguished from frogs by their rough, wart-covered backs, their dull colors, large and puffy bodies, smaller hind feet, shorter hind legs, lack of agility, and their land-going habits. The hopping amphibians which every summer shower brings out on sidewalks and country paths, usually are toads. Altogether, there are about eighty-five species, mostly tropical. The majority live upon land, a few burrow into the earth, and a few live in the water. There are many species so frog-like that it is difficult to note the characters (chiefly of internal anatomy) which distinguish them.

THE COMMON TOAD² may stand as the representative of the Toad Family of North America. The long-legged, lightly

¹ *Hy'la ver'si-col-or.*

² *Bu'fo len-tig-i-no'sus.*

built frog leaps gracefully and far; but the plethoric Toad is content to wriggle or hop briefly through life. Its existence depends largely upon the fact that as yet man finds no value in it, and does not regard it as worth killing. When Toads



COMMON TOAD.

become salable at five cents each, their extermination will follow soon.

The Toad deposits its eggs in water, in long strings, and after the transformation they grow so slowly that even in August the toadlets are so minute that about three could sit upon a copper cent. They seem more like insects than amphibians with bony skeletons. In winter these creatures hide away in the deepest crevices they can find, or the cavities of hollow trees, or holes in the earth, and lie dormant until spring recalls them to life.

*THE BURROWING TOADS**Pelobatidae*

THE SPADE-FOOT TOAD¹ of the eastern and southern United States represents this large Family, of which two species only are found in the United States, and eighteen elsewhere. In the North, it is rarely seen and little known. Personally I know nothing of it in life. Holbrook states that it is the commonest toad in the South; that it digs for its burrow a small hole about six inches deep, in which it lies in wait for every insect that may be tempted to enter. It seldom leaves its hole except in the evening, or after long-continued rains. This animal is 2 inches long, and its color is brown above, with dark patches.

THE TONGUELESS FROGS

Excepting the members of two small Families, all frogs and toads have tongues. Of the Tongueless Frogs, one species—which is universally called a “Toad”—is of special interest in illustrating a very curious feature of frog life.

THE SURINAM TOAD,² of Dutch Guiana, is celebrated among naturalists all over the world because of the remarkable manner in which its eggs are cared for and hatched. Just previous to the egg-laying period, the skin of the back of the female is specially prepared by Nature for a remarkable proceeding. It becomes very thick, spongy and soft. The eggs are taken by the male Toad, and one by one are *embedded in the skin on the back of the female*, so effectually

¹ *Sca-phi-o'pus holbrook-i.*

² *Pi'pa americana.*

that the skin closes over them, and each egg becomes partially encysted, and retained in a cell of its own.¹ There they remain until they are fully incubated, the tadpole stage is passed, and a tiny, but perfect Toad emerges *from the skin of its mother's back!*

The number of young usually produced at one hatching is from 60 to 70, and the period of incubation is from seventy-five to eighty-five days. At the close of this process, the thickened layer of skin on the back of the female loses its vitality, and is shed very much as a snake sheds a dead epidermis. Although the front feet of the Surinam Toad are small and webless, the hind feet are of great size, fully webbed, and so much drawn in at the ends of the toes that in swimming the foot is saucer-shaped.

There are other frogs which display remarkable intelligence in the production of their young, their methods going far beyond what one would expect in creatures as low in the vertebrate scale as the amphibians. As a whole, the members of this Order offer a wide field for the specialist.

¹ For a full description of the process, see the Proceedings of the Zoological Society of London, 1896, p. 595.

CHAPTER XLVI

ORDER OF TAILED AMPHIBIANS

URODELA

THE members of this Order are readily distinguished from the preceding group by the possession of tails, which they retain throughout their lives; by their gills, which most of them retain permanently; by the absence of scales, and by the fact that with very few exceptions they are strictly aquatic. It is safe to say that any four-legged aquatic creature having a tail but no scales, is either a salamander, newt, mud-puppy or siren.

THE ORDER U-RO-DE'LA is the dividing line between the finny, gill-breathing fishes, and the four-legged, lung-breathing, land-going lizards. Strange to say, its members are most abundant in the temperate regions of the earth, and except in two or three small areas, are absent from the tropics. In Australasia there are none, and in South America and Africa there are none save in their extreme northern portions.

Of all countries, the region embracing the United States and the southern provinces of Canada is by far the richest in species belonging to this Order, the total number present being 52. Mexico and Central America contribute 14 more, all salamanders. In this total of 66 species 18 genera are

represented, 14 of which are found only in the New World. The total number of species in the Old World is only 36. In North America, the northern boundary of the Order Urodela is a line extending due east and west across the continent about on the 52d parallel of latitude. ("Amphibia and Reptiles," Dr. Hans Gadow, pp. 95-96.)

THE FAMILY OF SALAMANDERS.

Salamandridae

The members of this Family seem to be engaged in a continuous struggle at the dividing line between lungs and gills, and exhibit all possible variations between perfection in both those organs. One species (the axolotl) changes from water to land with neatness and despatch. Another (the striped-backed salamander) lingers for two or three years in its larval state, in the water, while the blue-spotted salamander lives upon land, in moist forests. But one or two illustrations must suffice for all.

THE AXOLOTL,¹ of Mexico, is in some respects the most striking—even theatrical—example of salamandrine life and character. Its transformation is so rapid and complete that it is highly impressive. As an Axolotl, it is either a dark gray or a perfectly white and almost translucent animal, about 7 inches long, with external gills divided into three long, ragged branches; a long tail with a continuous fin above and below, and four very practical legs. This is the larva.

If the pond in which this creature lives threatens to dry up, the gills and the fins on the tail and back begin to shrink

¹ *Am-blys'to-ma ma-vor'ti-um.*

and disappear, and the animal begins to breathe air at the surface of the water. Finally, when the transformation is complete, a lizard-like animal with very serviceable lungs, no gills whatever, and not a vestige of fins on tail or back, emerges upon the land, and thereafter leads a terrestrial life. It is then known as a SPOTTED SALAMANDER; and it is no wonder that for many years these two forms were considered creatures of different species. It was in the Jardin des Plantes, in Paris, that the process of birth, growth and transformation was finally discovered.

It is not difficult to bring about the transformation of the Axolotl, by gradually diminishing the water supply, and thus observing from day to day the progress of the change. More than this, the transformation can be arrested by gradually diminishing the allowance of air, thus forcing the imperfect Spotted Salamander back into aquatic life. At first there is a struggle against life under water, but finally the animal becomes adjusted to it. (R. L. Ditmars.)

By keeping the larval Axolotl in an aquarium, with an abundance of water but with no encouragement nor facilities for breathing air, it not only remains in that stage indefinitely, but it breeds successfully.

This species is most abundant in the shallow lakes around the City of Mexico, but it inhabits nearly the whole of Mexico and also a considerable area in the southwestern United States. Unquestionably, the wonderful mobility—as it may truly be called—of this creature is for the purpose of enabling it to survive in a region wherein droughts are common, and where the life of an aquatic animal depends upon its ability



THE TWO LIVES OF THE AXOLOTL.

The lower figure shows the wholly aquatic larval form, with gills and tail fins, called the Axolotl. The upper figure shows the same creature fitted for life on land, and known as the Spotted Salamander.

to change from water to land. Of all members of the Order Urodela, this is to me the most wonderful.

SALAMANDERS, GENERALLY.—In shallow brooks, in still pools of all kinds, from the shaded woods of the East to the wind-swept, sun-bathed prairies and bad lands of the West, and both on and in the damp earth of forests high and low, we occasionally find little smooth-skinned, lizard-like animals. They are slow in movement, weak and incapable of either defence or flight, and are at the mercy of almost any species larger than themselves. These are Salamanders, and in view of the fact that some are wholly aquatic and others wholly terrestrial, it is difficult to choose from our sixteen species one which may stand for the majority. The diversity of habit of these animals is greater than their differences in form. The various members of the group inhabit all sorts of quiet situations from the rocks and dry ground of the *Blotched Salamander*¹ to the mountains of the *Blue-Spotted Salamander*,² and the swift-running streams of the *Dusky Salamander*.³

Very frequently, salamanders are found underneath fallen trees, or stones, or under the bark of decaying logs; and on the western prairie farms the ploughshare turns into the broad light of day many a burrowing amphibian.

On the whole, the SPOTTED SALAMANDER⁴ appears to be the best species with which to introduce the North American group. It is distinctly marked, and of wide distribution. Its length is 6½ inches, its body is broad and full, and its tail is shorter than its body. Above, its ground-color is dark brown

¹ *Am-blys'to-ma o-pa'cum.*

³ *Des-mog-na'thus fus'ca.*

² *Pleth'o-don glu-ti-no'sus.*

⁴ *Am-blys'to-ma punc-ta'tum.*

or black, on which is laid about thirty irregular yellow spots. The Spotted Salamander of Europe is a different species, its light markings being in the form of elongated patches or bands. Except for its external gills, the larva of this species looks much like an ordinary tadpole; but with transformation the gills disappear. Occasionally this species is found in spring-houses and cellars.

THE NEWTS, OR TRITONS

Pleurodelidae

Although quite abundant in the Old World (sixteen species), the newts are represented in America by only two species. All these tiny creatures inhabit water during the breeding-season, but at its close some species leave it, and live for a period upon land, where their habits are much like those of terrestrial salamanders.

Most species of newts look very much like small, weak, scaleless lizards, except that in some species the males, and in others both sexes, have broad fins on the tail, above and below. In some cases the upper fin is prolonged forward along the back, quite up to the head.

Of our two species of newts, the CRIMSON-SPOTTED NEWT¹ endeavors to make up by its abundance for the scarcity of species of the Genus *Triton* in America. It is quoted by herpetologists as "very common in ponds everywhere" in the State of New York, and its known range embraces the northern and eastern portions of the United States. It is about 3½ inches long. Its color above is brown, or greenish

¹ *Diemyctylus viridescens*.

brown, with two rows of bright vermilion spots, in all from 6 to 12. Its under surface is orange, marked with small black dots. Half-grown specimens are brownish red, with the characteristic spots of bright red.

This puny little animal inhabits deeper water than most salamanders, and swims freely, often in an upright position, in which the hind legs hang motionless while the tail does all the work. It feeds upon the larva of aquatic insects, worms, and very small mollusks. For schoolroom aquaria, Newts are more easily obtained than any other of the tailed amphibians, and they are easily kept.

Our Newt has long been of much interest to American naturalists, and its complicated series of changes from the egg to adolescence have been carefully studied and reported upon.¹

The Newt of western North America (*Triton torosus*) is one of the largest of the genus, and attains a length of 6 inches. The tail is longer than the body, much flattened vertically, and is provided with a dorsal and ventral fin. The underparts are colored yellow.

THE FAMILY OF AMPHIUMAS

Amphiumidae

Unfortunately there is no English name which properly applies to the members of this Family. Some are like salamanders, and some are like eels; but none are "fish-like" salamanders, as they are sometimes called. In the perfect state they are without gills, the gill-clefts being in a vanish-

¹ See L. J. Gage in the *American Naturalist*, 1891, p. 1084.

ing stage, either reduced to a pair of small holes, or totally absent. Both jaws are provided with teeth, but the eyes are without lids.

This Family consists of two genera and three species, two of which are found in the United States, the other in Japan.

THE HELLBENDER, or MENOPOMA,¹ is one of the ugliest-looking creatures on this continent. When fully adult it is from 18 to 20 inches in length, its head and body are much flattened, while its tail is flattened vertically and completely finned. Its legs and feet are short and thick, and all along the middle of each side is a wide, convoluted fold of skin.

Its color is a uniform dull brown, accentuated by a few dark blotches of very irregular shape. On the left side there is a gill-opening, but on the right there is none; and there are four pairs of gill-arches. The skin is smooth, but the head bears many wart-like tubercles.

This unpleasing animal is found in many of the streams that flow into the Ohio River, and the Mississippi also, but it is most abundant in Pennsylvania, especially in streams whose sources are in the Alleghanies. In its food habits it is very voracious, feeding upon worms, minnows and crawfish, and often taking the hooks of fishermen in quest of that most repulsive of all American fishes, the catfish. Fishermen hate the Hellbender; but between catfish and Hellbender there would seem to be small choice.

The Hellbender is very tenacious of life, and it is said that it can live on land for twenty-four hours without perishing. On this point, Mr. William Frear offers the following testimony:

¹ *Cryp-to-bran'chus* (or *Men-o-po'ma*) *al-le-gha-ni-en'sis*.

“One specimen, about 18 inches in length, which had lain on the ground exposed to a summer sun for forty-eight hours, was brought to the museum, and left lying a day longer before it was placed in alcohol. The day following, desiring to note a few points of structure, I removed it from the alcohol in which it had been completely submerged for at



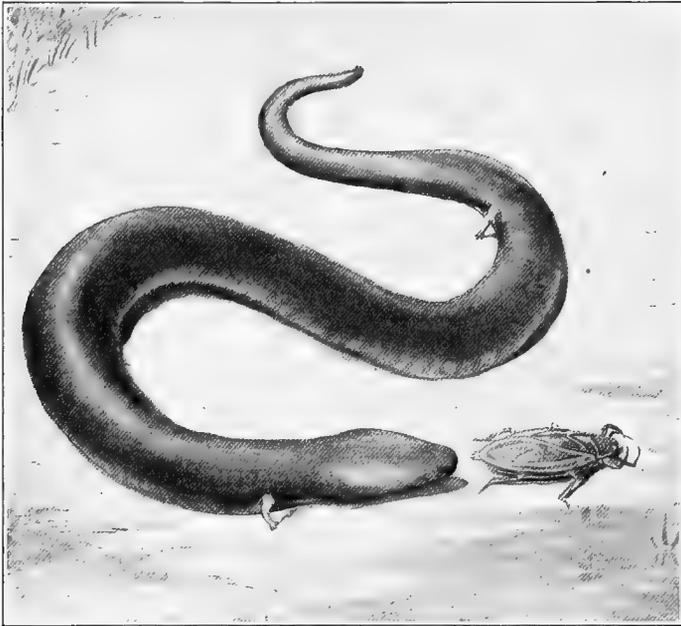
MENOPOMA, OR HELLBENDER.

least twenty hours, and had no sooner placed it on the table than it began to open its big mouth, vigorously sway its tail to and fro, and give other undoubted signs of vitality.”

THE GIANT SALAMANDER,¹ of Japan, is a brother species to the hellbender, but is very much larger. It is the largest of all the amphibians, and sometimes attains a length of 3 feet. Specimens may always be seen in the Reptile House of the Zoological Park.

¹ *Cryp-to-bran'chus max'i-mus.*

THE CONGO "SNAKE," or EEL-LIKE SALAMANDER,¹ is in many ways related to the foregoing species, but in external appearance it seems widely different. In appearance it looks like a blunt-nosed, wide-mouthed eel, with a tiny pair of legs



Drawn by J. Carter Beard.

THE CONGO "SNAKE," OR EEL-LIKE SALAMANDER.

close behind its head, and another pair about four-fifths of the way back to the end of its tail. Even in a small aquarium tank, in a well-lighted reptile house, these tiny legs are so thread-like and so short they are seldom noticed save by those who know they are present, and look specially for them. The absurd little feet on these ridiculous legs have but three

¹ *Am-phi-u'ma means.*

toes, and the wonder is that such useless or "aberrant" appendages have not long since disappeared altogether.

The color of the Eel-like Salamander is a uniform gray-brown, and its length when adult is usually about 2 feet. There is a gill-opening on each side of the neck, and there are four internal gill-arches. There are no external gills. These creatures inhabit the muddy streams and stagnant waters of our southeastern states, and are in the habit of burying themselves in the mud, sometimes to a surprising depth. They feed upon every form of aquatic animal life which is small enough to be seized and swallowed—insects, worms, crustaceans, shell-fish, and even small fishes. In the South they are occasionally found in the ditches which irrigate the rice-fields.

FREE-GILLED SALAMANDERS

Proteidae

This very small Family contains only three genera, with but one species in each. One of these, the OLM¹ of Europe, is recognizable at sight by its general eel-like appearance, its tiny legs far apart (like the Congo "snake"), and the big bunch of external gill-branches waving on each side of the neck, close to the head. This animal is totally blind, and is found only in the caverns of the Alps.

THE MUD-PUPPY, or MENOBRANCHUS,² bears a strong external resemblance to the hellbender, but is readily distinguished from the latter by the conspicuous mass of external gill-branches with which the animal fans the water at every

¹ *Pro'te-us an-guin'e-us.*

² *Nec-tu'rus mac-u-la'tus.*

breath. It inhabits many of the rivers of Ohio, Pennsylvania, Indiana, the Great Lakes, and northern New York, and is often taken in fishermen's nets.

THE SUBTERRANEAN PROTEAN OF TEXAS.—Very recently a rather startling discovery was made in Texas, near San Marcos. From the bottom of an artesian well 188 feet deep, there



THE MENOBRANCHUS, OR MUD-PUPPY.

came up with the water several blind Proteans, colorless and white, which up to that time had lived only in the subterranean streams and pools of the earth's crust, and were quite unknown. Along with them came four new species of Crustacea (crab-like creatures); and doubtless it was upon those that the Proteans lived. Unfortunately, thus far those who received the new amphibians have not succeeded in inducing them to eat, and none have survived. The species has been christened *Typh-lo-mol'ge rath'bun-i*.

*THE TWO-LEGGED SALAMANDERS**Sirenidae*

Near the foot of the Class *Amphibia*, we find the TWO-LEGGED SALAMANDERS, of which there are only two species, both American. Both look very much like the Congo "snake"; but the hind legs are totally absent, and external gills are conspicuously present. The front legs, which are



SIREN SALAMANDER, OR MUD "EEL."

close behind the gills, are larger than in any other of the eel-like salamanders, and are of some slight use.

THE SIREN SALAMANDER, or MUD "EEL,"¹ of our southeastern states, has four toes on its feet, three pairs of gill-openings, a smooth skin of a dull-black color, and when fully adult a length of about 24 inches. The habitat and habits of this creature correspond closely to those of the Congo "snake" of the southern rice-fields and swamps.

¹ *Si'ren la-cer-ti'na.*

*THE ORDER OF WORM-LIKE AMPHIBIANS**Apoda*

Last and lowest in the Class *Amphibia*, we find a group of creatures that externally seem more like worms than vertebrates. It is interesting to know that there are true vertebrates so very worm-like that they have neither legs, feet, nor fins. Some, however, have overlapping scales, like fishes.

Collectively, these animals are called CAECILIANS (pronounced se-sil'i-ans). There are forty species, inhabiting the lower half of Mexico, Central and South America, equatorial Africa, India, Burma and northern Australasia, but not the United States. They are of burrowing habits, and their skulls exhibit a degree of solidity and strength quite in keeping with the necessities of creatures which can burrow only with their heads. Many of them are totally blind—by the concealment of their eyes under the skin or the maxillary bones. (Gadow.) The exact relationships of the Apoda are yet to be determined conclusively.

FISHES

CHAPTER XLVII

INTRODUCTION TO THE CLASS OF FISHES

THE study of fishes is called *ich-thy-ol'o-gy*.

So great is the number of species that the mass is, at first thought, fairly bewildering. During the last twenty years the researches of the men who devote their lives to the study of fishes (called ichthyologists) have brought to light hundreds of new forms.

The inhabitants of the waters of North America, alone, form a great multitude. Of the fishes found north of Panama, marine and inland, the "Descriptive Catalogue" of Drs. Jordan and Evermann, Part IV, completed in 1900, enumerates the following groups, species and subspecies as recognized by those authors:

Orders of Fishes.....	30
Families.....	225
Genera.....	1,113
Species.....	3,263

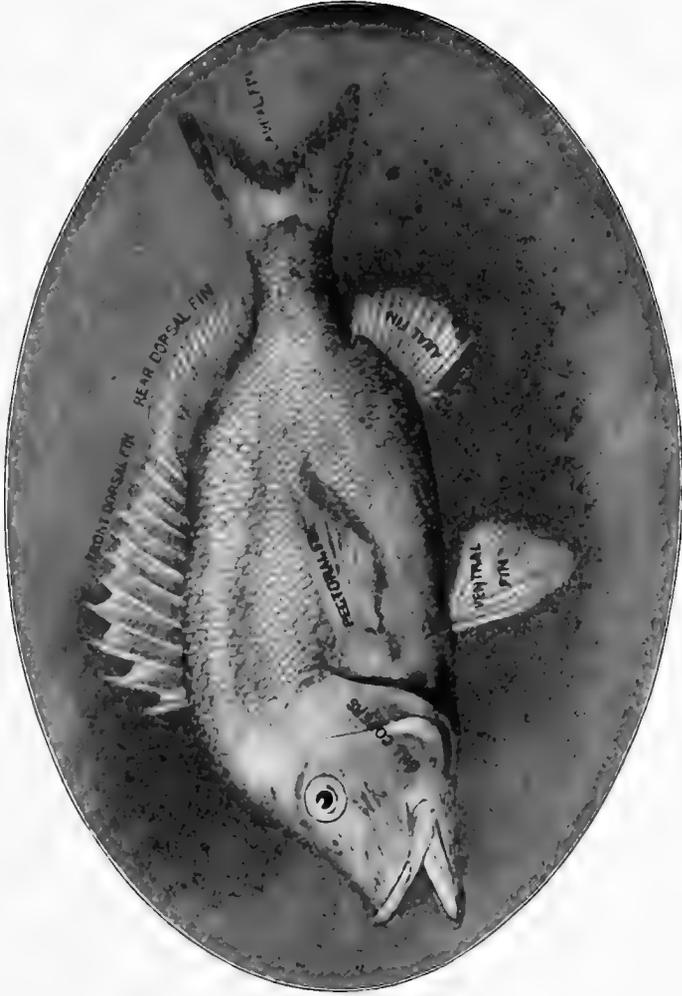
The four volumes comprising the work mentioned above make a pile nine-and-a-half inches high, and contain 3,313 fine-print pages of text, and 392 plates. The "Systematic Arrangement," or table of contents, is wholly in Latin, and fills 95 closely printed pages. The work has been carefully

devised to be of no use whatever to any one save an ichthyologist.

When this array confronts the general student, the prospect is appalling. From the first page to the last, every technical work on fishes abounds in descriptive terms that to most persons are about as attractive as the spines on a porcupine fish. If the general reader attempts to master them, he soon finds himself involved and discouraged, and the desired general view of our finny tribes is obscured in fog.

But the whole subject of fish study is merely a matter of method. With fishes, as with the other vertebrates, the *Orders* are the master keys by which a proper exhibit can be unlocked and displayed. At the same time, the Subclass divisions are of great importance, and must constantly be kept in mind. Leaving out the deep-sea fishes, which we can well spare for the present, there are twenty well-defined Orders, the types of which are almost as easily known and remembered as a score of pictures in an art gallery. *The Orders must not be lost sight of*, for when they are firmly grasped by the understanding and the memory the fog begins to rise.

GENERAL CHARACTERS.—A typical fish is a cold-blooded animal, with a bony skeleton, an elongated body which is covered with overlapping scales, and an outfit of fins for balancing, steering and propulsion. It has gills instead of lungs, fixed eyes, and a swimming-bladder, and is specially fitted for a wholly aquatic life. It is provided with teeth, it hears sounds by the transmitting power of the bony plates of the skull, and usually it lays eggs for the production of its young.



THE NAMES OF THE FINS OF A TYPICAL FISH.

The species shown is the Black Grunt (*Haemulon plumieri*), and it represents the large and commercially important Family of Grunts (*Haemulidae*), represented in our warm waters by about 55 species.

The body of a typical fish is wedge-shaped, narrowest at the tail, thin from side to side, and the head tapers to a blunt point. This form is specially designed for rapid and easy progress through water.

The Black Bass may fairly be regarded as a perfectly typical fish.

The variations from the perfect type are almost innumerable. For example:

The Lung-Fish has foot-like fins, and practical lungs.

The Catfish has no scales.

Some Sharks and a few other fishes bring forth their young alive.

The Rays and Skates are the flattest of all vertebrates.

The Climbing Perch can climb.

The Flying-Fish can rise from the sea, and fly.

The Lantern-Fish, of the deep sea, carries a phosphorescent light upon its head.

The anatomy of fishes is a special branch of knowledge in which the general reader can scarcely be concerned, but for the ichthyologist there are many special works. Books for the identification of all the known species of fishes in North America are now available for those who desire them. At present, however, we are concerned only with the twenty great groups, or Orders, and the fifty or sixty important types which represent them. Of these there must be some serious study.

Up to this date, nearly every systematic writer upon the Fishes as a Class has chosen either to alter or ignore previous classifications, and adopt the arrangement which to him has

seemed most logical and reasonable. In order to conform to this time-honored custom, I have elected to do likewise.

With the subdivisions of the Orders, we are not at present seriously concerned, our main object being to block out the larger groups only. The arrangement of Orders set forth on pages 172-173 is called a "practical arrangement" because it can be understood, and is available for practical, every-day use.

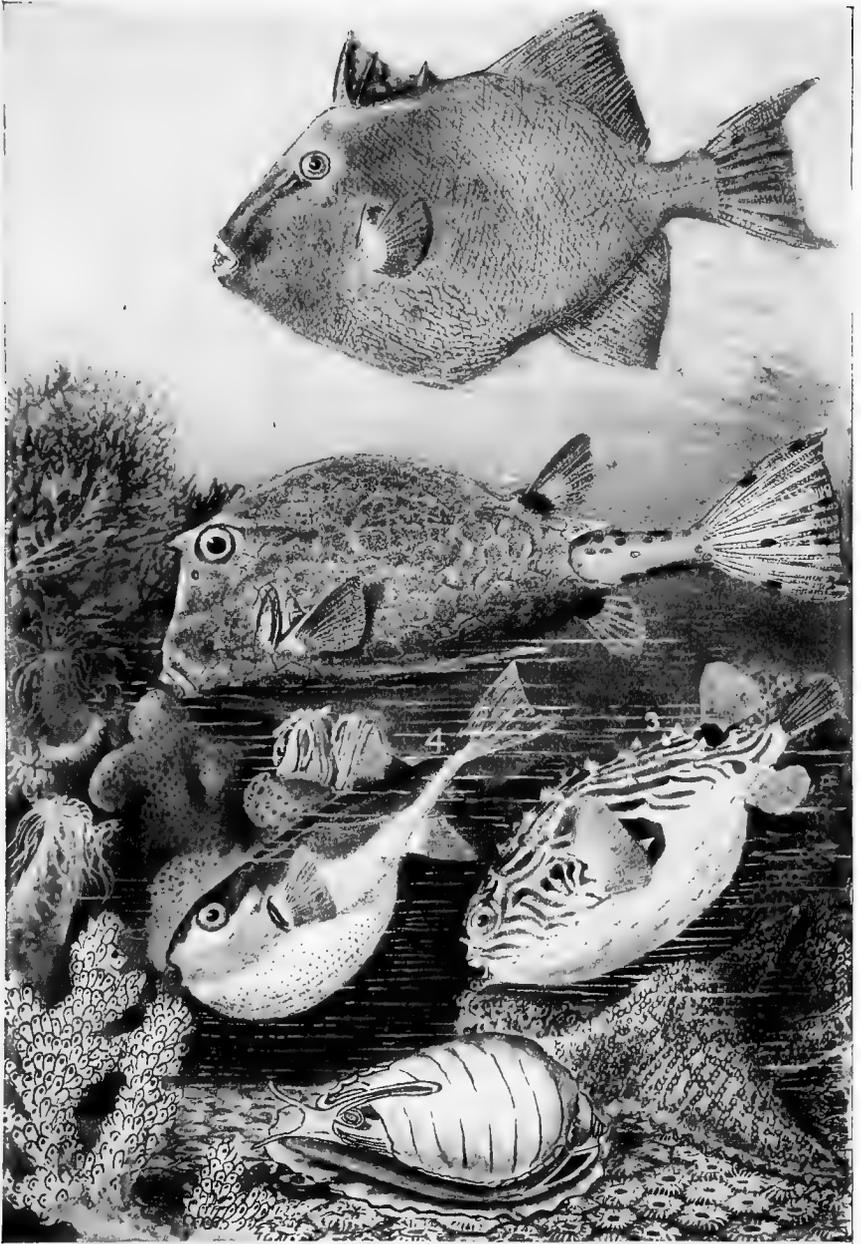
THE FISHERY INDUSTRIES AND FISH PROPAGATION

At the present date (1914), the commercial fisheries of the United States, including Alaska but excluding our insular possessions, employ about 225,000 persons and 7,500 vessels, with an aggregate capacity of 217,000 tons. The total amount of capital invested is about \$65,600,000, and the initial value of the various fishery products is about \$76,000,000.

Although the price of nearly all fish products, including oysters, clams, lobsters and crabs, has greatly increased during the past ten years, the fishes of our waters still remain the cheapest of all good and wholesome meat foods, and are almost as vitally important as coal and wood.

Naturally, the onslaughts of the commercial fishermen on the visible supply of food fishes is terrific, and with the alarming decline now apparent in the supply of beef cattle, the value of the food fishes will be further increased. To-day the United States Bureau of Fisheries, as the propagator and preserver of fishes, is engaged in a hand-to-hand struggle with the fishing industry to maintain the available supply.

There are comparatively few laws which are intended to



REMARKABLE MEMBERS OF THE ORDER OF SOLID-JAW FISHES.

1. Trigger Fish (*Balistes capricus*).
2. Box Fish (*Ostracion tricornis*).

3. Porcupine Fish (*Chilomycterus geometricus*), inflated.
4. Puffer (*Tetodon turgidus*), with air-sac inflated.

limit the catch of commercial fishes, but the "sportsmen" have provided many state laws for the preservation of the high-class "game" fishes. Nearly every state maintains a fish commission, and many maintain one or more hatcheries for the production of young fishes with which to renew the supply of depleted waters, or to introduce species into new waters.

In 1871 Professor Spencer F. Baird—whose services to his country are now remembered by only a very few persons, and to whom not one worthy monument exists—induced Congress to create the United States Fish Commission, for the propagation and distribution of food fishes, and the general preservation of the food-fish supply. In 1902 the annual appropriation for this bureau was \$543,120. It was about that time that the title of the Commission was changed to Bureau of Fisheries, and it was placed in the newly created Department of Commerce and Labor.

The growth of the Fisheries Bureau has kept pace with the increasing importance of its work, and the increase of 50 per cent in the annual value of the fisheries product. For the year 1914 the annual appropriation for maintenance is \$1,709,720. In 1902 the total output of the Bureau of eggs and live fish and lobsters was 1,494,543,374 and in 1913 it was 3,863,593,282. This vast output was composed as follows: Eggs, 422,275,873; fry, 3,421,591,295, and fingerlings, yearlings and adults, 19,726,114.

In view of the very great importance of the governmental efforts to maintain and also increase the supply of valuable food fishes, it becomes us to know what species of fishes are

being propagated, and the quota of each for a single year. The following statement brings our information down to the close of the past year (1913):

PRODUCTION AND FREE DISTRIBUTION OF FISH-EGGS AND LIVE FISH BY
THE UNITED STATES BUREAU OF FISHERIES, DURING THE YEAR 1913

	IN 1913	IN 1902
Catfish.....	62,446	95,970
Carp.....	79,160	....
Buffalo Fish.....	3,084,212	200,000
Shad.....	136,638,850	106,986,000
Whitefish.....	467,600,000	594,490,000
Lake Herring.....	4,730,000	....
Silver Salmon.....	14,356,083	424,530
Chinook Salmon.....	72,001,056	48,683,718
Blueback Salmon.....	82,340,902	3,371,000
Humpback Salmon.....	153,680	....
Dog Salmon.....	19,479,000	....
Steelhead Trout.....	5,418,635	534,882
Rainbow Trout.....	3,158,327	1,675,121
Atlantic Salmon.....	3,496,768	638,765
Landlocked Salmon.....	557,742	822,220
Black-Spotted Trout.....	21,246,010	1,868,500
Loch-Leven Trout.....	75,200	96,760
Lake Trout.....	30,231,524	26,260,490
Brook Trout.....	12,534,097	6,579,762
Golden Trout.....	....	69,950
Grayling.....	3,516,000	1,803,258
Scotch Sea Trout.....	....	24,531
Smelt.....	6,377,000	....
Pike and Pickerel.....	9,004	805
Crappie and Strawberry Bass.....	79,279	738,671
Rock Bass.....	64,743	37,170
Warmouth Bass.....	1,390	100
Small-Mouthed Black Bass.....	341,941	262,157
Large-Mouthed Black Bass.....	1,257,302	....
Sunfish (Bream).....	203,623	623,739
Pike-Perch.....	194,710,000	237,099,575
Yellow Perch.....	376,748,132	1,700
White Perch.....	469,120,721	....

	IN 1913	IN 1902
Striped Bass.....	7,234,000	.....
Yellow Bass.....	255	.....
Cod.....	227,812,000	212,001,000
Pollock.....	563,799,000	.....
Haddock.....	126,125,000	.....
Flatfish.....	809,270,000	168,133,000
Lobster.....	199,680,200	81,020,000
Total.....	3,863,593,282	1,494,543,374

The distribution of this enormous output required 641,250 miles of travel, 123,394 miles of which were performed by the special cars of the Fisheries Bureau, and the remainder by detached messengers. All transportation was paid for with the exception of 12,314 miles of car service, and 81,355 miles made by messengers.

In order to obtain these enormous annual supplies of young fish and fish-eggs, covering forty-five species of food fishes, the Government maintains thirty-four permanent fish-hatcheries, open and operated all the year round, and one hundred and two subhatcheries, auxiliaries and egg-collecting stations. These are scattered through thirty different states and Alaska. This industry may be regarded as a great ever-working machine, in constant operation to put back seed-stock in the place of what the commercial and other fishermen annually take out of our waters. In addition to this many states have state hatcheries. The one recently finished by the state of Kansas, at Pratt, under the direction of Professor L. L. Dyche, is said to be the most extensive and mechanically perfect single hatchery thus far developed in America.

The thirty-four permanent hatcheries of the National Government may be classified as follows:

Atlantic rivers, for salmon, shad, striped bass, yellow perch and white perch.....	4
Pacific rivers, for salmon and steelhead trout.....	5
Great Lakes, for whitefish, cisco, lake trout, and pike-perch.....	4
Interior waters, for bass, sunfish, crappie, trout, etc.....	18
Atlantic coast, for cod, haddock, pollock, flounder and lobster.....	3
	34

It is perfectly safe to say that without this enormous putting-back effort, for the perpetuation of the supply of food fishes, *very few food fishes would now remain in the fresh waters of the United States!* No wonder Congress cheerfully appropriates for the work of the Fisheries Bureau, for 1914, the sum of \$1,709,720.

But is there any such movement as this on the part of the Government for the preservation of our supply of game birds and game quadrupeds? Emphatically, there is not. The nearest approach that the National Government has made to the pace set in behalf of the fishes is the preservation of the bison and the preservation of the elk of the Yellowstone Park, on which, *all told*, perhaps \$200,000 have been expended up to 1914. Now a third step is being taken, this time in behalf of the birds of the nation. All the states are willing that the National Treasury should place fishes in their waters, public and private, but when the National Government attempts to save the migratory game birds from slaughter in spring, by the new migratory bird-law, the duck-hunters of Kansas City raise a great outcry about the alleged "unconstitutionality of the law," and seek to overthrow it on that ground!

Will the American people permit even an attempt to

destroy the most valuable bird-law ever placed in any statute-book in the United States, state or national?

The Biological Survey needs \$250,000 per year with which to hire wardens to enforce—all over the United States—the provisions of that law, and it is confidently expected that Congress will cheerfully grant it.

The United States Bureau of Fisheries has not entered extensively into the business of procuring legislative enactments for the regulation of fisheries, but has left the bulk of that work to the various states concerned. However, in view of the local obstacles now being placed in the way of legitimate fish protection and propagation, it would seem that the time is at hand when the Bureau must, in self-defence, fight the fish-destroyers by procuring the enactment, in various states, of adequate laws. For example, on December 4, 1913, United States Fish Commissioner Hugh M. Smith made the following statement:

“The shad in the Chesapeake basin is doomed unless the states take radical action which would insure the survival of at least a small percentage of the run of spawning fish.”

Now, will the states concerned bestir themselves and act sensibly in time to save their most valuable fish supply—and the shad is the king of all food fishes!—or will they, through slothfulness and inaction, destroy their own finest fish property forever? The choice now is theirs; and they can take it or leave it.

Incidentally, I think it now has become very necessary that in such cases as this the Fisheries Bureau should take measures to show state legislatures the path of duty, after

the methods of the Biological Survey. The following is from the annual report of Commissioner Smith for the year 1913:

“The most serious conditions with which the Bureau has to contend, however, are of an artificial nature. The construction of dams without efficient fishways; the operation of nets in prohibited waters, or at the mouths of streams, thus preventing the adult fish from reaching their spawning-grounds; and the destruction of fishes and fish-food through water-pollution, are some of the factors which nullify the fish-cultural work of the Bureau in some sections of the country; while the failure of some of the states to enact or enforce adequate protective laws, and the disposition of others to appropriate to their own use fields which have been developed and are already occupied by the Bureau, tend to hamper and curtail its activities.”

THE VALUE OF FISH STATISTICS.—Many persons regard figures and statistics as dry reading, and inventions of the enemy. To the giddy mind they do not appeal. To the wise reader they are—when properly chosen and set forth—valuable means to a better understanding of the affairs and the interlocking relations of men.

To the angler who thinks only of Permachine belles and silver doctors, figures relating to the annual output of black bass and other game fishes may seem wearisome and unprofitable; but even in fishing, good figures have their uses. The present cost of beef and mutton invests our food fishes with new interest; and we hold that it is important to know how well or how ill the supply is holding out in the various sections of our country. In the matter of geographical distribu-

tion, we will do well to consider the annual catch of the fishes wherever we live.

Unfortunately for our inland fishes, the latest statistics for the whole country are nearly ten years old! There should have been a complete canvass in 1908, the year before the publication of the last census. Once every five years we need to know where we stand. The statistics of the marine fisheries of the North Atlantic and Alaska are kept well in hand by the Fisheries Bureau, and the oyster industry is fully reported upon each year, but we do need to know more about the maintenance—or the decrease—of our inland fishes.

We have been at some pains to set forth in the succeeding pages some of the latest figures obtainable for our nation's fishes, because we believe that the facts they represent are of practical value to our subject.

A PRACTICAL ARRANGEMENT OF

BASED CHIEFLY UPON VISIBLE CHARACTERS; DEEP-SEA

SUBCLASSES	ORDERS AND CHARACTERS	TYPES AND EXAMPLES	PAGE
LUNG FISHES: Nearest to the <i>Amphibia.</i>	LUNG-FISHES..... <i>Si-ren-oi'de-i</i> Fishes with partial lungs, rudimentary legs, and molar teeth.	AUSTRALIAN LUNG- FISH.....	174
		SOUTH AMERICAN MUDDFISH.....	176
	SPINY-FINNED FISHES..... <i>Ac-an-thop'te-ri</i> . Typical fishes, with perfect gills, fins, scales and bony fin-rays.	BASS..... SUNFISH..... PERCH..... BLUEFISH..... MACKEREL..... TUNA..... MULLET..... RED SNAPPER..... DOLPHIN..... SWORDFISH..... REMORA.....	177 184 190 193 195 197 203 206 208 209 212
	PIKES..... <i>Ha-plo'mi</i> Head flattened and scaly. Only one dor- sal fin, far back.	PIKE..... MUSKALLUNGE..... PICKEREL.....	215 215 216
	TROUT AND SALMON..... <i>I-so-spon'dy-li</i> ... Differential characters relate wholly to bony anatomy.....	HERRING..... MENHADEN..... TROUT..... SALMON..... TARPON..... SHAD..... WHITEFISH.....	218 218 220 228 244 247 250
BONY FISHES: Typical Fishes, high and low forms.	FLYING FISHES..... <i>Syn-en-tog'na-thi</i> Pectoral fins greatly enlarged; some spe- cies able to fly.	FLYING FISH.....	252
	SOLID-JAW FISHES..... <i>Plec-tog'na-thi</i> ... With solidified teeth and strong jaws. Mostly with rough, file-like skins.	TRIGGER-FISH..... BOX-FISH..... PUFFER..... PORCUPINE FISH...	254 255 256 256
	SUCKERS AND MINNOWS.. <i>Plec-to-spon'dy-li</i> Differential characters based wholly upon bony anatomy.	COMMON SUCKER... BUFFALO FISH..... CARP..... MINNOWS.....	258 260 261 263
	HALF-GILLED FISHES..... <i>Hem-i-bran'chii</i> . With imperfect or incomplete gills.	STICKLEBACK.....	265
	CATFISHES..... <i>Nem-a-tog'na-thi</i> Scaleless; head broad and flattened; bar- bels around mouth; defensive spines in dorsal and pectoral fins.	MISSISSIPPI CATFISH BULLHEAD.....	270 271

THE ORDERS OF LIVING FISHES

ORDERS OMITTED. TYPES CHIEFLY NORTH AMERICAN

SUBCLASSES	ORDERS AND CHARACTERS	TYPES AND EXAMPLES	PAGE
BONY FISHES: <i>Continued.</i>	FLAT-FISHES..... <i>Hel-e-ro-so'ma-ta</i> Without bilateral symmetry. Both eyes on one side. Flat, oval. Swim in hori- zontal plane.	} COMMON HALIBUT..	274
	FOOT-FISHES..... <i>Pe-dic-u-la'ti...</i> Mouth enormous; body broad, flattened, bag-like. Pectoral fins long at base.			} ANGLER.....	277
	EELS..... <i>Ap'o-des.....</i> Body long, slender, snake-like. No ven- tral fins, no scales.	} ELECTRIC EEL.....	283
	PIPE-FISHES AND SEA-HORSES, <i>Lo-pho-bran'chi</i> Gills tufted; mouth tubular; body covered with scale armor. Very unlike true fishes.	} PIPE-FISH AND SEA- HORSE.....	286
GANOIDS: Armored Fishes and their allies	THE DOGFISH..... <i>Hal-e-co-mor'phi</i> Air bladder cellular, acting as rudimentary lung. Helmet-headed.	} DOGFISH OR BOWFIN	290
	GAR-FISHES..... <i>Ging-ly-mo'di...</i> Ancient forms, covered with formidable bony armor.	} GAR PIKE.....	294
	STURGEONS..... <i>Glan-i-os'to-mi...</i> Body with rows of large, bony plates. Mouth with barbels.	} LAKE STURGEON...	298
	PADDLE-FISH..... <i>Sel-a-chos'to-mi...</i> Scaleless, shark-like. Broad, bony pad- dle projecting from nose.	} PADDLE-FISH.....	303
CHIMERAS:	CHIMERAS..... <i>Chi-mae-roi'de-i.</i> Odd, shark-like forms.	} CHIMERA COLLEI...	306
CARTILAGI- NOUS FISHES: With soft skeletons. Lowest Fishes.	SHARKS..... <i>Squa'ti.....</i> Scales minute; skeleton cartilaginous. Many species bring forth their young alive.	} MACKEREL SHARK..	313
	RAYS AND SKATES..... <i>Ra'i-ae.....</i> Excessively flattened, but otherwise shark-like. Many species with long whip-like tails.	} HAMMER-HEAD....	313
		} SHARK-RAY.....	314
		} STING RAY.....	317
		} DEVIL-FISH.....	318

CHAPTER XLVIII

ORDER OF THE CONNECTING-LINK FISHES, WITH LUNGS AND LEGS

SIRENOIDEI

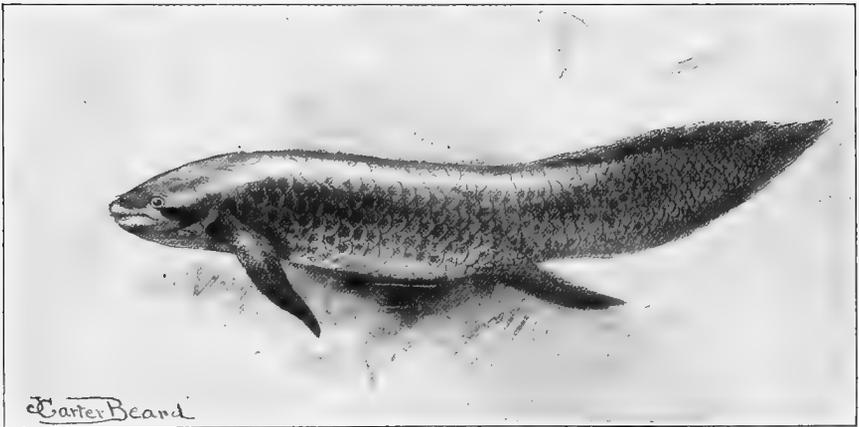
AS in the preceding sections of this work, we will begin our studies of the Class of Fishes with the highest forms, and run down in regular course to the lowest. Of the 144 Families composing this class, as it occurs in North America, it is impossible to mention separately more than a very few of those which are of greatest importance.

THE LUNG-FISHES are introduced because they are the highest of all the fishes, and form the connecting link between that class and the amphibians. Of the three genera that are known, one is found in Australia, two in Africa, one in South America, and in North America none.

To some ichthyologists, the great **AUSTRALIAN LUNG-FISH**¹ is the most interesting of all fishes. It is not only an intermediate form between the amphibians and fishes of to-day, but it is a creature that has far outlived its natural fate. Its congeners lie embedded in Jurassic rocks 500,000 years old; and how this poor orphan of the Past escaped with its life down to the Present many have wondered, but nobody knows. As you stand before the glass tank in the end of

¹ *Ce-rat'o-dus fors'ter-i.*

the Reptile House of the London Zoo, and behold a magnificent living *Ceratodus* four feet long, with an ancestry running back half a million years without a break, it makes one's brain whirl to reel in the idea. This creature's ancestors lived in the days when many fishes were struggling to develop legs and lungs, with which to go on land, and become salamanders



THE AUSTRALIAN LUNG-FISH.

first, then lizards. It is said that this fish sometimes leaves the water and goes about on adjacent mud flats, like the jumping fish of the Malay Peninsula; but the statement needs confirmation.

The Australian Lung-Fish is from 4 to 5 feet long, and it is said that its maximum weight is about 20 pounds. It breathes air over its palate like a reptile, and its swimming-bladder is so developed that it does duty as low-class lungs. Its gills are very small and imperfect, and of little use. The top of its skull is quite unlike those of other fishes, and its

scales are very large. Its pectoral and ventral fins are very long and leg-like, and are covered with scales everywhere save on the edges, where the fin-rays are situated.

One of the most extraordinary features of this strange fish is the possession of large and very remarkable molar teeth, those above being set in the palate (vomer), and evidently designed for the cutting up of vegetable food. Leaving bony anatomy out of consideration, it is quite clear that the living fish which stands nearest to *Ceratodus* is the jumping fish or mud-skipper, of the Malay Peninsula, which hops about on land with surprising independence and agility. Its long pectoral fins are really foot-like in usefulness.

Both in the Burnett and Mary Rivers of Queensland, where it lives, and also in captivity, this Lung-Fish frequently rises to the surface of the water to take breath, like a porpoise.

The allied *Mud-Fish* (*Lepidosi'ren*) of the Amazon, and the *African Mud-Fish* (*Protopterus*) of the River Gambia, have legs that are mere wisps of skin and flesh, and strongly resemble our *Amphiuma*, of the Class *Amphibia*. They are rarely seen alive in captivity.

CHAPTER XLIX

ORDER OF THE SPINY-FINNED FISHES

ACANTHOPTERI

EVEN of forms classed as North American, this gigantic and rather unwieldy Order contains 45 Families and 483 species. Fortunately the groups which are of general interest are sufficiently limited in number that it is possible to place representatives of them before the reader.

THE BASSES AND SUNFISHES

Cen-trar'chi-dae

The Bass and Sunfish Family enjoys, on the whole, the widest popularity of all the finny Families of North America. With due respect to the justly distinguished Trout Family, I believe its members are known personally to a much smaller number of people than those of the Bass Family. The reason is that the latter are abundant in the most densely populated portions of the United States, while the human neighbors of the trout are comparatively few.

This Family (of thirty species) leads from the narrow-bodied and athletic black bass, by regular gradations in breadth through the rock bass, calico bass, and their allies down to the little gem-like sunfish, with the extreme width of body and the limit of smallness and timidity. The black

bass fights like a wild-cat, the sunfish can be taken on a bent pin at the end of a cotton string; but observe this proportion:

The Sunfish is to the Small Boy as the Black Bass is to the Man.

It is good to find in Nature a Family whose members run from top to bottom in a stair-like series; for if so studied, the natural sequence is a great aid to the memory. We therefore begin with the narrowest fish, and descend to the broadest.

Surely, the **BLACK BASS**, be his mouth large or small, is a fish fit to head a Family. You can catch an eight-pound yellow pike-perch, and think you have hooked a bunch of weeds; but if you hook a two-pound Black Bass you know at once that you have engaged a Fish.

For its size, this is the bravest and the gamiest fish that swims in our waters. In size and in silver the tarpon is truly the silver king of game fishes; but if he had Black-Bass energy and courage in proportion to his size, no hook-and-line angler in a small boat would bring him alive up to the end of a twelve-ounce rod.

The Black Bass has the narrowest body and the darkest color found in the Bass Family. It is built for speed and strength, and colored for concealment. There are two species, so very much alike that there is practically but one point of difference—the size of the mouth; and naturally their habits are quite identical. It is important to remember, however, that in color and markings, individuals vary most strangely and unaccountably. Some are uniform dark and light; others are mottled, much and little.

THE SMALL-MOUTHED BLACK BASS¹ is the fish of the East and North, from western New Hampshire to Manitoba, and southward to South Carolina and the northern Gulf states to Arkansas.

It is a pity that so fine a fish should not be handsomely colored, but it is really very plain and unattractive. Its back is usually a uniform dull olive-green, the sides being somewhat lighter. A Bass of 3 pounds' weight may fairly be counted a large one, but this species has been known to attain a length of 18¾ inches, and a weight of 5 pounds.

This is strictly a clear-water fish, and for this reason its capture is a source of pleasure beyond anything that can be drawn from muddy waters. It takes live minnows, or worms, or a neat trolling spoon, but resists the hook and the dip-net to the last extremity. Its flesh is excellent, and its propagation a matter of both state and national importance. It has been planted successfully in so many bodies of water outside its original range that the limits of the latter are likely to be lost to view. "Black Bass are increasing all over the country, too much so in some places, as they are cleaning out the trout and other fishes from waters in which the Black Bass never should have been placed." (Hugh M. Smith.) In 1912 the number of Black Bass distributed by the Fisheries Bureau was 1,065,692.

The Small-Mouthed Black Bass has the corner of its mouth directly under the front angle of the eye, while the mouth of the LARGE-MOUTHED² species terminates under the rear corner of the eye. The range of the latter is from Man-

¹ *Mi-crop'ter-us dol'o-mieu.*

² *M. sal-moi'des.*

itoba, southward to the Gulf states, and spreads through the latter to Texas and Florida. The latest figures representing the annual catch of "Black Basses" are as follows:

Middle Atlantic states (1904),	168,170	pounds,	worth	\$14,657
South Atlantic states (1902),	648,235	"	"	70,524
Gulf states (1902),	84,730	"	"	5,835
Pacific states (1904),	93,500	"	"	2,910
	<hr/>			
	994,635	"	"	\$93,926

THE ROCK BASS, or RED-EYE,¹ stands next in width of body to the black bass, and intermediate between it and the next species. Sometimes the resemblance between the Rock and calico bass is so close as to be at first sight a little confusing. But spread the dorsal fin to its full extent, and it will tell the story. In the Rock Bass it is long, rather low, and its front half contains eleven stout spines, of nearly equal length. The calico bass has a short and high dorsal fin, with only seven large spines, and the body of the fish is of greater depth.

The Rock Bass is a fish of the Great Lakes region and Mississippi Valley—a clear-water fish, of habits quite similar to the black bass. Every way considered, it is a very perfect connecting link between the black bass and the next species. Its weight seldom exceeds 1½ pounds.

THE WARMOUTH BASS² is a fish of the South, and in form is an intermediate between the rock bass and calico bass.

THE CALICO BASS, or STRAWBERRY BASS,³ is a handsome and substantial fish. Its bright, silvery coat is beautifully

¹ *Am-blop'li-tes ru-pes'tris.*

² *Chae-no-bryt'tus gu-lo'sus.*

³ *Po-mox'is spa-roi'des.*



Drawn by J. Carter Beard.

1. SMALL-MOUTHED BLACK BASS.
2. CALICO BASS.

3. COMMON SUNFISH.
4. YELLOW PERCH.

mottled with olive-green blotches, so regularly splashed on as to suggest the pattern of a piece of calico.

Take, if you please, a beautiful bay on the southern shore of Lake Ontario, a sunny day in May, no hotels or cottages in sight, with red-winged blackbirds singing "*O-ka-lee'*" in the cat-tails, and the Calico Bass becomes one of the prettiest fish you can pull out of the water. Each time it gives a firm and vigorous bite, and leaves the water with a *swish* that once heard under proper conditions lives long in the memory.

I like the Calico Bass because it is so handsome, so well set-up, so substantial on the string and so satisfactory on the table. A large specimen measures only about 10 inches in length, but by reason of its great depth of body, and its thickness, too, it is a fish well worth having. Its weight never exceeds 2 pounds, and usually is about 1 pound. Besides the names given above, it is called the Grass Bass, Barfish, and "Crappie"; but the latter name belongs to another species.

The Calico Bass is at home throughout the whole region of the Great Lakes, the valley of the Mississippi to Louisiana and Texas, and along the Atlantic side down to the Carolinas and Georgia. In the beautiful lakes and ponds of Michigan, Wisconsin, and Minnesota it is abundant and highly valued. It can be taken still-fishing with worms, minnows, and grasshoppers, and also with a small trolling spoon.

It dislikes warm and muddy waters, it is a clean feeder, not quarrelsome or destructive to weaker species, and is said to increase rapidly. In 1900 only 7,544 were distributed by the United States Bureau of Fisheries, but by 1902 the

number of Calico Bass and crappie had risen to 738,671. The latest figures that make any showing of an annual catch of Strawberry Bass and crappie are as follows:

Mississippi River and tributaries (1903)	1,118,770 pounds, worth	\$53,224
Minor interior waters (1900-1903) . .	25,030 " "	810
	<hr/>	<hr/>
	1,143,800	\$54,034

It seems to me that for stocking northern lakes and ponds this is one of the most desirable of all the smaller fishes; and I wish long life and prosperity to the Calico Bass!

THE CRAPPIE¹ is a muddy-water understudy of the preceding species. In some portions of the North, the two species overlap each other, but in the main the Crappie is a southern fish.

THE SUNFISHES are divided into fifteen species, and as a group their range covers the whole of the United States eastward of the Great Plains. Poor indeed in fish life is the pond or stream between Maine and Texas, Dakota and Florida which contains no sunfish, bream, or blue-gills, pumpkin-seed, or dollaree. In about nine cases out of ten, the first fish that dangles from the first hook-and-line of the very small American angler is a sunfish. Small though it be, and feeble, it is yet a *Fish*; and it is large enough to open to Childhood the door to a great wonderworld of fish and fishing. Where is the veteran fresh-water angler who does not recall the electric thrills of his first "bite," and his first living, wriggling, scintillating sunfish! Blessings be upon their

¹ *Po-mox'is an-nu-lar'is*.

rainbow-tinted sides for the joys they have been, are and yet will be to Childhood!

Out of so many species it is difficult to select representatives, but it seems that first choice should fall upon the following:

THE COMMON SUNFISH, OR PUMPKIN-SEED.¹—This is the brilliant olive-green, blue and orange-yellow fish which, when taken dripping from the water, has all the colors of a green opal, and several more. It is distinguishable by the touch of bright scarlet on the lower portion of its gill-covers. It is found in clear ponds, large brooks, and other streams from Florida, northward and eastward of the Appalachian chain to Maine, thence westward through the Great Lakes region to Iowa and Manitoba. It is subject to considerable variations in color markings.

In the Great Lakes, this fish attains a weight of 1½ pounds, but elsewhere a specimen 6 inches in length and weighing 8 ounces is considered a large one.

THE BLUE-GILL OR BLACK-GILL² is the largest of the sunfishes. Its opercle, or gill-cover, terminates on the side in an ear-like flap which is of a deep black color; and this conspicuous character at once proclaims the species. This fish is found throughout the Great Lakes region and Mississippi Valley. It sometimes attains a length of 12 inches, and a weight of 1½ to 2 pounds, and in some localities it is an important market fish.

¹ *Eu-po-to'mis gib-bo'sus*.

² *Le-po'mis pal'li-dus*.

*THE SEA BASS FAMILY**Ser-ran'i-dae*

In the ocean and its dependencies there exists a Family which, in general form, and anatomy also, so closely resembles the fresh-water Bass Family that it is almost impossible to base distinctive characters upon skeletal differences. The Sea Bass Family, of North American waters, contains one hundred and four species, some of which are of colossal size. Whenever you go a-fishing in tropical or subtropical waters, and catch a large, thick-bodied, big-scaled fish that you cannot name, it is generally a safe hazard to call it a Sea Bass.

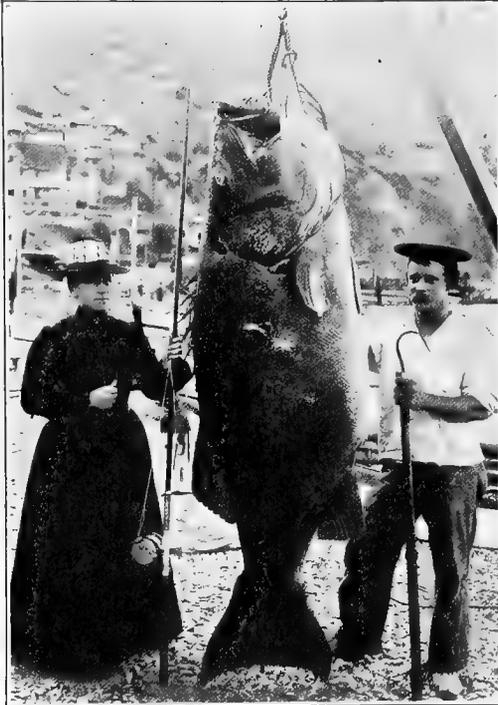
The great JEWFISH, or BLACK SEA BASS,¹ of Santa Catalina anglers, is one of the largest of the spiny-finned fishes. During the last ten years it has become celebrated because it permits itself to be outwitted so easily by the amateur angler. A very large fish can be caught with rod and line that seem absurdly light for such work.

What must we think of the courage of a 300-pound fish which will permit itself to be caught and gaffed on a line which will break under a strain of 50 pounds dead weight?

With heavy tackle, the catching of a large Jewfish would be no more of an event than would the pulling in of a Greenland halibut; but to go with one companion miles out from shore in a boat weighing from 125 to 150 pounds, catch a 300-pound fish on a 16-ounce rod, and kill it, without even

¹ *Ster-e-o-le'pis gi'gas*. It should be remembered that in another genus of this Family, called *Cen-tro-pris'tes*, there is another species, found along our Atlantic coast, that is also called the Black Sea Bass.

getting upset, is a feat worth while. If a large Sea Bass possessed the courage and fighting qualities, pound for pound, of the fresh-water black bass, it would take a hawser



Photographed by Ironmonger.

BLACK SEA BASS.

Caught at Santa Catalina, with rod and reel, by Mrs. A. W. Barrett, of Los Angeles. Weight, 416 pounds; length, 7 feet 10 inches; girth, 5 feet 11 inches. Time, 2 hours and 15 minutes.

and a donkey engine to handle the line, a tugboat to withstand the shock and a bomb-lance to kill the fish when alongside.

On our Atlantic coast, from Charleston to Brazil, occurs another huge fish to which the popular name "JEW FISH" is

applied. It is really the BLACK GROUPER.¹ Its normal weight is 500 pounds, and "only one specimen weighing less than 100 pounds" has been recorded. (Jordan and Evermann.) I have reason to know the appearance of this fish quite well. It is a great, hulking, coarse-grained creature, unattractive to the eye, except that of the successful light-tackle angler, and very inferior on the table. In no point has it the look of a high-class animal, for every line is coarse and plebeian; but it has the avoirdupois of a Wonder.

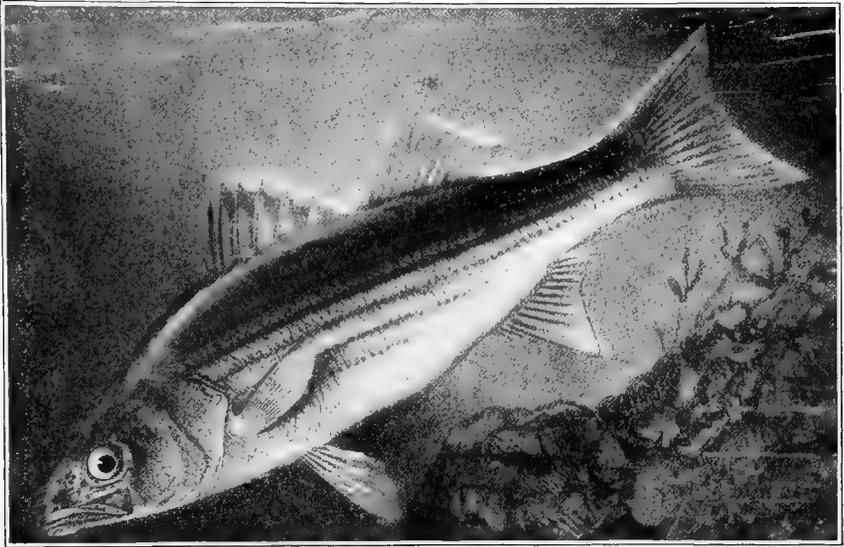
THE STRIPED BASS,² ROCK FISH or ROCK, is the finest representative of the whole great Family of Sea Basses. It is a fish of handsome form and colors, its table qualities are excellent and it is a persistent breeder. Its ground-color is silver-white, on which is laid, along the upper two-thirds of the body, a series of seven straight, equidistant stripes of black. It is a fish of large size, often attaining a weight of 85 to 90 pounds, and its flesh is most excellent. In the markets it stands next in desirability to the shad and blue-fish. The greatest weight recorded for this species (by Dr. G. Brown Goode) is 112 pounds.

The centre of abundance of this fine fish is now from Fire Island, New York, to Albemarle Sound, on the coast of North Carolina. Many great catches have been reported, the most notable of which were the following: At Bridgehampton, New York, in 1874, 8,000 in less than a week; by Charles Ludlow, 1,672 bass at one set of a seine; at Norfolk, Virginia, 1,500 at one haul; in eight days of June, 1879, off Fire Island, one fisherman caught 10,164 pounds.

¹ *Gar-ru'pa ni-gri'ta.*

² *Roc'cus lin-e-a'tus.*

The full range of the Striped Bass is from the St. Lawrence River to New Orleans, both along the coast and in all the great rivers which flow into that region. At Cuttyhunk Island, and in scores of other places also, angling for this fish



STRIPED BASS, OR ROCK FISH.

by heaving and hauling through the surf is pursued as one of the most fascinating kinds of sport.

One of the greatest hits ever made by the United States Bureau of Fisheries in the planting of fish in new localities was the introduction of the Striped Bass into the coast waters of California. In 1879, 135 live fish were deposited in Karquines Strait, at Martinez, and in 1882, 300 more were planted in Suisun Bay, near the first locality chosen.

Twelve years after the first planting in San Francisco Bay the markets of San Francisco handled 149,997 pounds

of Striped Bass. At that time the average weight for a whole year was 11 pounds and the average price was ten cents per pound. Fish weighing as high as 49 pounds have been taken, and there are reasons for the belief that eventually the fish of California will attain as great weight as those of the Atlantic and the Gulf.

The San Francisco markets now sell annually about *one and one-half million pounds* of Striped Bass. This fish has taken its place among anglers as one of the game fishes of the California coast, and affords fine sport. In 1897 the California markets handled 2,949,642 pounds, worth \$225,527. In 1897 the catch for the whole United States amounted to 5,996,882 pounds, worth \$440,222, but in 1904 the total catch of "Striped Bass" and "Rock Fish" for the whole United States (U. S. Census, 1909) was only 3,466,871 pounds, worth \$155,525.

The last word of the United States Fish Commissioner regarding this fish is as follows: "The Striped Bass of the Pacific coast has attained extraordinary abundance, and is distributing itself naturally along the coast, north and south of the waters in which it was originally planted."

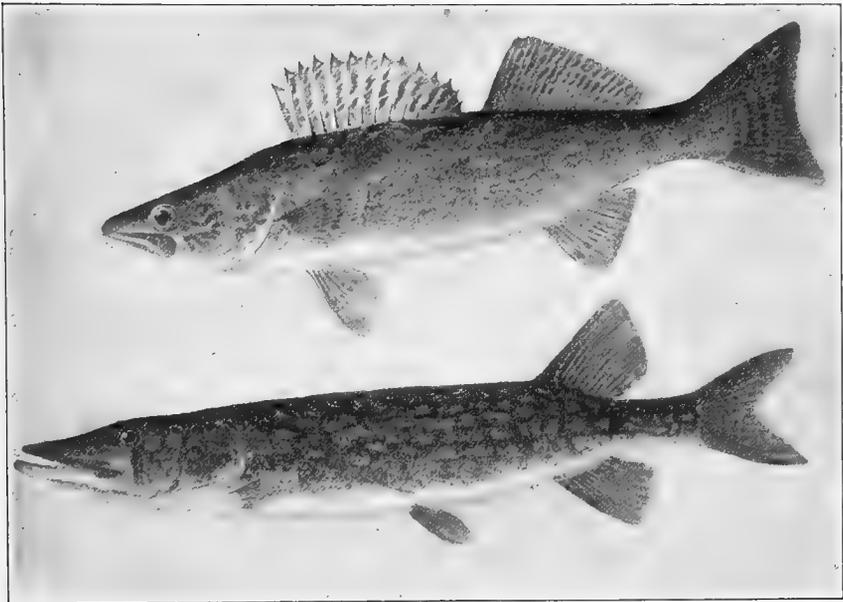
THE PERCH AND PIKE-PERCH FAMILY

Per'ci-dae

The festive little YELLOW PERCH¹ is, to the small angler, the next step upward from the sunfish—a sort of half-way fish on the road to the black bass and tarpon. And there is many a worse thing in the fishing line than a good string

¹ *Per'ca fla-ves'cens*. See illustration on page 181.

of beautiful bright golden-Yellow Perch. When crisply and daintily fried in a small modicum of meal, and laid on hissing from the spider, they are "pan-fish" worth while; and they make up in delicacy and richness of flavor all that they lack in size. The Yellow Perch at Chazy, Lake Champlain, are of



1. YELLOW PIKE-PERCH.

2. CHAIN PICKEREL.

the brightest golden-yellow color of any ever taken by the writer, and they are very beautiful.

Like egg-rolling rights on the White House lawn every Mayday, this neat little fish belongs to the small citizen; but in the Great Lakes and a few other places it is so numerous and so large that it takes rank as a desirable market fish. It is at home in the northeastern quarter of the United States,

north of the Ohio and Missouri valleys from Maine to Iowa and Minnesota. In most of the lakes, ponds and fresh-water bays of New England generally it is fairly abundant. Its rule of life is to bite at everything that is offered at the end of a line—angle-worm, minnow, grasshopper, frog-leg, trolling spoon and fly, either natural or hand-made. The size of this fish varies from half a pound to 3 pounds, with a possible $4\frac{1}{2}$; and in length it measures from 7 to 12 inches.

The latest figures in existence at this date (1914) showing an annual catch of Yellow Perch are as follows:

Northeastern states (1905),	10,000	pounds,	worth	\$800
Middle Atlantic states (1904),	471,893	“	“	19,108
South Atlantic states (1902),	105,992	“	“	5,639
	<hr/>			<hr/>
	587,885	“	“	\$25,547

THE YELLOW PIKE-PERCH¹ is frequently called the YELLOW “PIKE” and WALL-EYED “PIKE”; but it is not a real pike at all. The real pike is a blood brother to the muskallunge. The Pike-Perches have *two prominent dorsal fins*, the real pikes only *one*.

Twice in trolling with hand-lines I have caught my spoon full of eel-grass. On hauling in to clear the tackle, each time the eel-grass turned out to be an 8-pound Yellow Pike-Perch. The first one came into the boat like a bunch of wet weeds. The second finally roused to a realizing sense of its position, and made quite a demonstration, but chiefly in the boat, endeavoring to climb out.

In the eastern United States this is a northern fish that goes southward almost to the Gulf states. It is abundant in

¹ *Sti-zos-ted'i-on vit're-um*.



THE BLUE-AND-YELLOW ANGEL-FISH.

Lakes Ontario, Erie and Huron, and in many of the bays and larger streams attached to them, in which the water is clear and the bottom of sand and gravel. By very many persons this fish is well liked as a food fish, and immense numbers are propagated every year.

The last-reported catches of "Pike and Pickerel" for a single year were as follows:

Mississippi River and tributaries (1903),	707,093	pounds,	worth	\$26,296
Great Lakes (1903),	300,076	"	"	15,698
Minor interior waters (1900, 1903),	286,742	"	"	27,683
	1,293,911	"	"	\$69,677

MISCELLANEOUS SPINY-FINNED FISHES

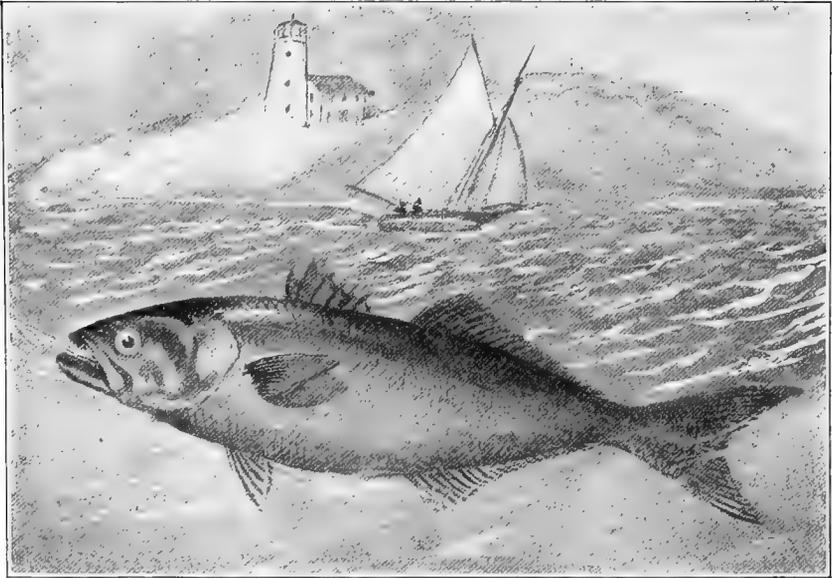
THE BLUE-AND-YELLOW ANGEL-FISH,¹ of Bermuda and other tropical waters, is about 15 inches in length, and in its color pattern it is one of the most beautiful of all fishes. Around the Bermudas its favorite haunts are the wonderful coral barrier reefs known as the "Sea Gardens." It represents the Family of Scaly-Finned fishes (*Chae-to-don'ti-dae*) familiarly known as Chaetodons. Specimens are frequently to be seen in the New York Aquarium.

THE BLUEFISH² is a fish for men. To take it in orthodox fashion, go to treeless but delightful Block Island, pay your dollar-fifty, take deck passage on a low-browed, broad-beamed cat-boat, don a full suit of oil-skins, and set sail for blue water. If the wind is so light that the sailing is uninteresting, you get no fish. But if there is a stiff breeze, and you go up and down the eastern side of the island at racing

¹ *Hol-a-can'thus cil-i-ar'is*,

² *Po-mat'o-mus sal-ta'trix*.

speed, the Bluefish will come chasing after you to bite at your dummy fish, and give you a hundred thrills to the minute while you are hauling them in. If it happens that the bite of a bear has put two of the fingers of your right hand



THE BLUEFISH.

out of commission, that hand will have all it can possibly do to grasp the line adequately and haul in.

Fishing for Bluefish in a good breeze—with not too much sea on—is like hunting mountain sheep amid grand scenery. Half the sport is in the fine surroundings.

Drs. Jordan and Evermann say that this fish is found all the way from our coast to the Cape of Good Hope, the Mediterranean, the Indian Ocean, and the Malay Archipelago, “a wandering fish . . . sometimes disappearing from certain

regions for many years at a time." Professor Baird always considered it, of all our coast fishes, one of the most destructive to marine life, a genuine wolverine of the sea.

The Bluefish swim in schools, ready to pounce upon anything edible that comes along. Once a cat-boat from which four of us were fishing sailed swiftly through a school. Within about five seconds four fish struck in a rush that was practically simultaneous, and amid flying spray and general excitement four vigorous victims of misplaced confidence were hauled aboard. A fish which is so greedy that it kills more fish-prey than it can use surely is a good fish to pursue for sport.

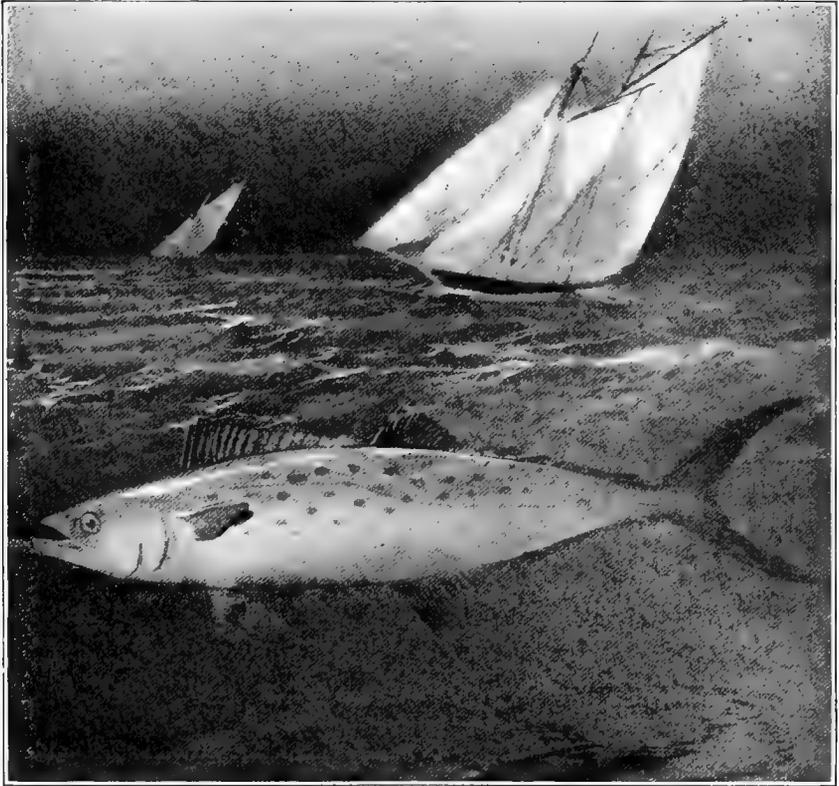
On our coast this fine fish is fairly common from Florida to northern Maine, ranging in size from 5 to 20 pounds. As a food fish it ranks on the bill of fare next to shad. Owing to its known voracity, it is debited with the annual destruction of an enormous quantity of other fishes. On the hook it is savagely courageous, and fights to the last.

Of all North American fishes this species stands fifth in commercial value, being surpassed only by the Pacific salmon, cod, shad and mullet. In 1897 the catch amounted to twenty million pounds, worth \$643,705, but in the latest reports of the United States Fish Commissioner (1911, 1912 and 1913) the Bluefish is not once mentioned! This leads us to infer that the annual catch has heavily declined.

THE SPANISH MACKEREL¹ may stand as a typical representative of the Mackerel Family (*Scombridae*), in which we find the *Common Mackerel* of the North, the *Kingfish* of our

¹ *Scom-be-rom'o-rus mac-u-la'tus.*

tropical waters and the *Tuna*. It is a large and showy fish, colored silvery white and dark metallic-blue, and no cruise in Floridian or Cuban waters is complete without it. It is a



THE SPANISH MACKEREL.

favorite in all markets reached by it, and in flavor it is a fair rival of the bluefish.

To every sportsman the finest thing about this fish is the catching of it, on a one-hundred-foot line and a hook baited with that least appetizing of all baits this side of angle-

worms—a white rag! Like the bluefish, the Spanish Mackerel and kingfish both bite best when the sails are well filled, and the boat is making about twelve miles per hour. In 1902 the total catch for the United States amounted to 1,703,224 pounds, valued at \$112,342, but for 1912 or 1913 no figures are available.

It would require many pages to contain a really adequate life sketch of this interesting fish, which ranges most erratically, in great schools—or in none at all—from the Gulf of Mexico to Block Island. It comes north only in the spring and summer, and does not go far into waters that are colder than 65°. (G. Brown Goode.)

Apparently, specimens taken in northern waters average much smaller than those taken around the two coasts of Florida. Dr. Goode says this fish “sometimes attains a weight of 8 or 9 pounds, though it rarely exceeds 3 or 4 pounds.” A specimen of 3 pounds 5 ounces measured 26¼ inches in length. Drs. Jordan and Evermann give its weight as “6 to 10 pounds,” with a maximum of all “seen” of 25 pounds weight, and 41 inches in length. (“American Food and Game Fishes.”)

The great leaping TUNA¹ of the enchanted waters of Santa Catalina, “the tiger of the California seas,” is, on our Atlantic coast, the big but commonplace HORSE MACKEREL, TUNNY, or GREAT ALBACORE—no more, no less. It is the largest and now the most interesting member of the Mackerel Family.

At Santa Catalina bold men, and women, too, go out

¹ *Thun'nus thyn'nus*.

with rod, reel and line, to angle for this monster, and vanquish Strength and Weight by Tackle and Skill.

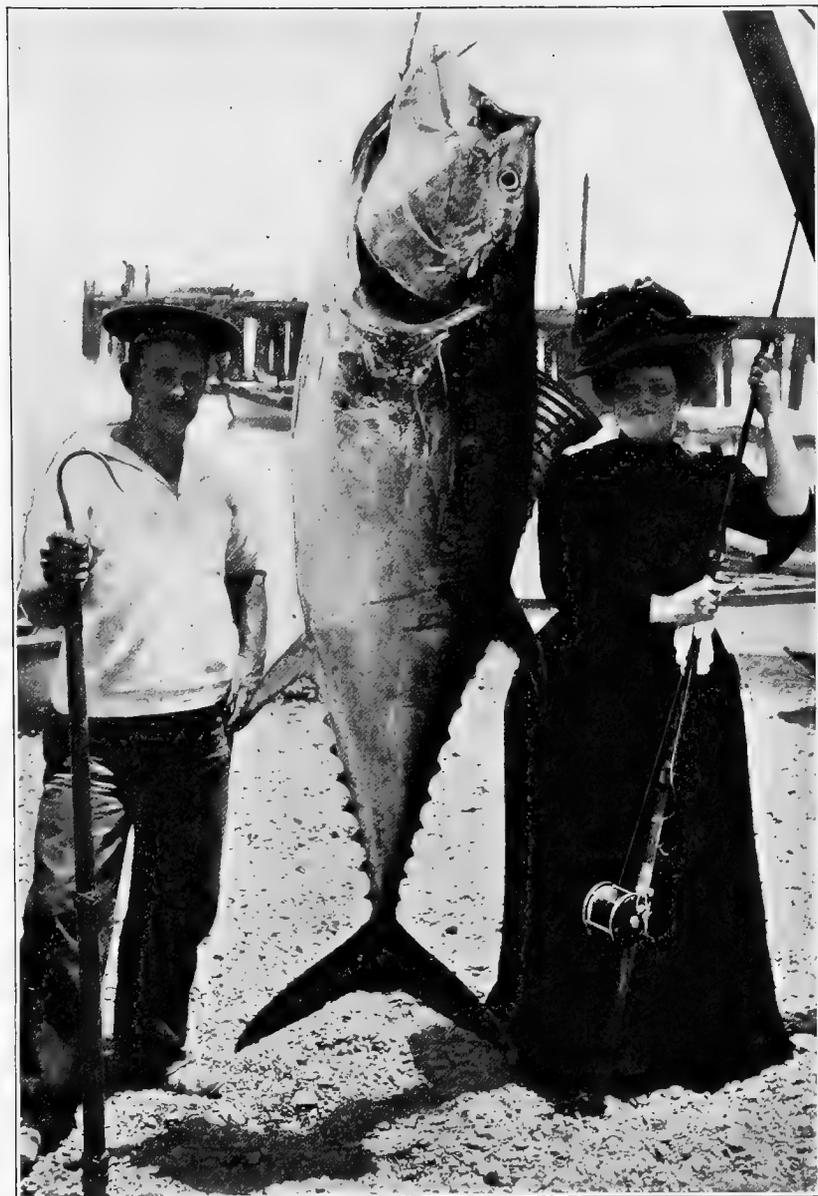
This is hook-and-line fishing with a vengeance. The beginner hopes to catch a Tuna heavier than 100 pounds, in order to gain membership in the Tuna Club. The club member always hopes either to improve his own record or break all others; but, record or no record, the button of the Tuna Club is a good thing to wear by right of conquest.

Beyond question, when treated as a game fish, and fairly challenged with rod and line in the watery arena of Santa Catalina, in more senses than one the Tuna is great! Mr. C. F. Holder—for two years literally the holder of the Tuna championship with a 183-pound fish which fought four hours, and towed his captor ten miles—says that the Tuna, “when played with a rod that is not a billiard cue or a club will give the average man the contest of his life. My idea of a rod is a 7 or 8½ foot greenheart or split bamboo, with a good cork grip above the reel, the latter of Edward vom Hofe’s make, with a leather pad, brake and click.”

The sport in catching a Tuna *à la* Santa Catalina consists in bringing the monster within gaffing distance by the aid of the rod and reel alone. The hooked fish leaps into the air, or rushes seaward, or to the bottom, or plays on the surface like an escaped fire-hose—in all directions at once.

The game consists in tiring out the fish without a break, and sometimes ten miles and ten hours of strenuous struggle are reeled off between the start and the finish.

The beautiful waters of Avalon Bay, the bare and frowning mountain sides rising like the walls of a rock-built colos-



Photographed by Ironmonger.

THE TUNA.

Caught at Santa Catalina, with rod and reel, by Mrs. E. N. Dickerson, of New York.
Weight, 216 pounds. Time, 1 hour and 55 minutes.

seum, and the houses of the little town clustering at its foot like a gathering of living and interested spectators, make up a stage setting for the Tuna fisherman sufficiently romantic to quicken the sporting instinct of the most blasé tourist who ever swung a rod.

Concerning the kind of tackle in use by the members of the Tuna Club, and by himself, Colonel C. P. Morehouse, of Pasadena, holder of the Tuna championship record from 1899 down to date (1914), has kindly furnished the following statement:

“The most of the Tuna fishermen use a greenheart rod, as per the rules of the club, viz., 6 feet 9 inches long, and a 16-ounce tip. As for myself, I prefer a split bamboo of the very best quality made. I caught the large Tuna (251 pounds) with the longest and lightest rod ever used for Tuna, viz., split bamboo, 7 feet 4 inches long, tip 12 ounces, with a 21-strand Cuttyhunk line on a reel made to order, to carry 300 yards. The time was 3 hours and 20 minutes. I do not think a lighter rod than the above would stand the strain necessary to capture a Tuna of 251 pounds, or even 150 pounds.

“The Tuna are hooked by trolling from light naphtha launches, and flying-fish are used for bait.”

At this date (1914) the heaviest catches of Tuna by members of the Tuna Club stand as follows:

Colonel C. P. Morehouse, Pasadena, 1900.....	251 pounds
Mrs. E. N. Dickerson, New York, 1901.....	216 “
John E. Stearns, Los Angeles, 1902.....	197 “
C. F. Holder, Pasadena, 1899.....	183 “
L. G. Murphy, Converse, Ind., 1910.....	175 $\frac{1}{4}$ “
Ernest E. Ford, Alhambra, Cal., 1902.....	174 “
C. B. Stockton, Los Angeles, Cal., 1911.....	170 “

The rules of the annual tournaments in which such records are made are very severe and strict. The angler must make his catch unaided, the fish must be reeled in and a broken rod constitutes a disqualification. The rod must measure not less than six feet nine inches, the tip must not exceed five feet in length, and it may not weigh more than sixteen ounces. The line must not contain more than twenty-four threads and must sustain a dead weight not exceeding forty-eight pounds.

On our Atlantic coast the Horse Mackerel is not sought by anglers as a game fish. Its average length is put down as "about 8 feet." It feeds chiefly upon menhaden, and, inasmuch as its appetite is in proportion to its size, it is considered very voracious. In its turn, this great fish is to the killer (*Orca gladiator*) an ideal food fish, and from the latter it receives special attentions which the Tunny would gladly forego.

One of the largest specimens on record, as vouched for by Dr. Storer, was taken in 1838, off Cape Ann, and measured 15 feet in length. Its weight of "1,000 pounds" was undoubtedly an estimate only.

THE POMPANOS.—Following closely after the members of the Mackerel Family comes a large Family of deep-bodied fishes, with very small and narrow scales, deeply forked tails, and with the dorsal and anal fins prolonged to nearly, if not quite, one-third the entire length of the fish. They are really warm-water fishes, but often stray out of their regular haunts into colder waters. This Family includes the amber-jack, the cavallas, the moon-fishes, and several others. Of this Family the following species is the best type:

THE COMMON POMPANO¹ is a good fish for the table, but unfortunately its mouth is so small it is next to impossible to take it with a hook. Once when penned up by bad weather in the mouth of New River, Florida, where this fish was abundant, we fished for Pompano until we almost starved. The "Silver King" tantalized us daily by showing himself at the surface, but his vagrant pounds of flesh were almost as far beyond our reach as the stars.

The Pompano is essentially a fish of the two coasts of Florida, and the northern half of the Gulf of Mexico. It is one of the most highly prized fishes in the markets of its home waters, and as a rule the supply seldom is equal to the demand. The *Jacks* are more common. Several of the species found in this Family are characterized by the enormous thickness of their ribs—a very peculiar character, which makes them look like ribs afflicted with elephantiasis.

Mr. John T. Granger, of Washington, regards the *Permit* or *Great Pompano*² as a game fish well worthy of the attention of salt-water anglers, and believes that it will become a general favorite. A struggle with a 27-pound fish, taken with rod and reel at Miami, Florida, revealed to Mr. Granger the game qualities of the Permit.

THE MULLET.—Throughout the sounds, and bays, and half-salt rivers of the Carolinas, Florida and the Gulf states, the mullets are omnipresent and highly prized. When better fishes fail you, they can be depended upon to fill the dish; and you may go far without finding a more toothsome morsel than a SILVER MULLET,³ or WHITE MULLET, freshly snatched

¹ *Trach-i-no'tus car-o-li'nus.*

² *T. goodei.*

³ *Mu'gil bra-sil-i-en'tis.*

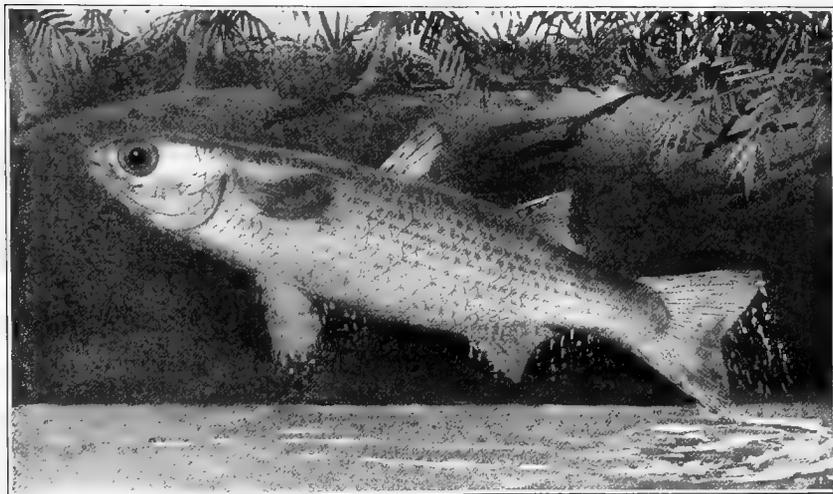
from its native element with a fling of the cast-net that experience alone can give. If you wish to beguile the Silver King, you first catch a Mullet, or buy one, for bait.

The name of this fish brings vividly to mind the balmy air and placid waters of Indian River, Florida, in February; a little, mangrove-clad archipelago along its eastern shore; herons squawking hoarsely in the green tangle; and small fishes of glistening silver jumping a yard high in front of a lotus-eater's boat. The Mullet leaps high in the air, gleaming and dripping, from pure joy in being alive amid such beautiful surroundings; and, having attained his zenith, he relaxes and falls back broadside upon the water, with a startling "*slap.*" In one quiet evening hour afloat, you may see thirty or forty Mullet leap out of water, and to some persons the sight is even more welcome than the flight of a bird.

The Silver Mullet is a very trim little fish—big-scaled, round-bodied and swift. In external appearance it is very much like a pygmy tarpon, and quite as silvery. It is really a small fish, averaging about 9 inches in length, and as food for other fishes and fish-eating birds it is ideal. The brown pelicans of Pelican Island delight in this fish. When Mrs. Latham playfully squeezed the neck of a big, clumsy young pelican in the down, it promptly disgorged nine good-sized Mullet. I have seen a darter, with a neck 1 inch in diameter, swallow a 9-inch Mullet with relish and despatch. One point, however, should be clearly understood. The idea that the few Mullet that are, or that might be, eaten by pelicans and other birds ever have made a visible depression of

the Mullet supply is extremely absurd, and should not for one moment be taken seriously.

The Mullet genus (*Mugil*) contains about seventy species, widely distributed throughout the warm waters of the world. Besides the species mentioned and figured above, the *Striped*



THE SILVER MULLET.

Mullet is also abundant in the waters of our southeastern coast. Both are important food fishes, and are caught in great numbers for the southern markets. They are taken in gill-nets and cast-nets, and the largest specimens rarely attain a weight of 6 pounds.

Of all North American fishes, the Mulletts rank high in commercial value. In 1897 the total catch amounted to 21,402,624 pounds, which sold for \$332,090. Of this the yield to Florida alone amounted to 16,700,094 pounds.

Later statistics show a great increase in the annual Mullet

catch, indicating that the supply is maintaining itself, as follows:

Middle Atlantic states (1904),	324,935 pounds,	worth	\$10,183
South Atlantic states (1902),	14,310,808	“ “	256,348
Gulf states (1902),	27,098,435	“ “	442,536
	<u>41,734,178</u>	“ “	<u>\$709,067</u>

THE SNAPPER FAMILY

Lu-ti-an'i-dae

THE RED SNAPPER¹ brilliantly represents a large and important Family of valuable food fishes, which in our waters contains about 35 species. Many of these fishes are handsomely and showily colored, red being the commonest and most conspicuous tint, with yellow tints of frequent occurrence. A typical Red Snapper is recognizable a hundred feet distant by the clear and beautiful crimson color which completely suffuses it.

The average market specimen is about 16 inches long, but it is stated that this species attains sometimes a length of 3 feet, and a maximum weight of 40 pounds. In the Gulf of Mexico, says Mr. Silas Stearns, they very seldom exceed 30 pounds in weight, and the average is 8 or 9 pounds. It happens, however, that one can spend months on the coast of Florida, and around Key West, without even once seeing a Red Snapper reaching 25 pounds in weight.

This fish prefers to live on a rocky bottom, in holes and gullies where all kinds of marine animals and fish are abundant. These gullies occur at a depth of from twelve to forty-five fathoms, and are most numerous in the northern border

¹ *Lu-ti-an'us ay'a.*

of the great level plain of sand which stretches out as the Gulf bottom from Cedar Keys toward the delta of the Mississippi.



THE RED SNAPPER.

Within easy reach of Jacksonville, Florida, are fishing-banks so well populated by the Red Snapper, and other fishes also, that excursions are made to them with great success. Dr. C. J. Kenworthy described for Dr. Goode

("Game Fishes of North America") a day's sport twelve miles offshore from Mayport, which for eighteen fishermen yielded 208 Red Snappers averaging 25 pounds each. The bait used was bluefish, young shark or skip-jack. The only serious drawback to this fish is the fact that "it should always be boiled, or cooked in a chowder." This reminds me that as nearly as I can figure it out the people of the South are losing each year the food value of about \$1,670,265 worth of good fish, like the sheepshead and others, *through not knowing how to boil them* into fine, tasty dishes! In Florida the average boiled fish is beneath contempt; and it is due to the ignorance of the cook.

In 1897 the fishermen of Florida caught 5,314,487 pounds of Red Snappers, worth to them \$171,234. Later on the total catch for the last year fully reported upon (1902), was as follows:

South Atlantic states,	155,100 pounds,	worth	\$8,203
Gulf states,	13,608,553	" "	410,157
	<hr/>		<hr/>
	13,763,653	" "	\$418,360

ODD FISHES OF THE SPINY-FINNED ORDER

THE "DOLPHIN"¹ of this Order is a fish, not a cetacean of the Class of Mammals; and its unfortunate popular name and sea-going habits cause between it and the true dolphins much confusion.

This is the mid-ocean fish with a long, paddle-like body, a dorsal fin which reaches in one unbroken sweep from head to tail, and which possesses when alive the wonderful irides-

¹ *Cor-y-phae'na hip-pu'rus*.

cent colors which have tested the descriptive powers of so many voyagers.

This is the terror and destroyer of the flying fish. The "Dolphin" pursues it with tremendous speed and perseverance, often taking long leaps out of the water, until the victim is exhausted, overtaken and devoured.

The colors of the "Dolphin" are a mixture of all the colors of the solar spectrum, revealed with the metallic lustre and iridescence of the opal and the reticulated python. The fully grown fish is from 5 to 6 feet in length, and in contrast with the ordinary sailing-vessel diet of salt meat its flesh is a delicacy. To the writer it was a red-letter day when with a new artificial flying fish, fresh from the horny hand of an old sailor named "Porpoise George," he caught his first "Dolphin," in mid-ocean, from the deck of the *Golden Fleece*.

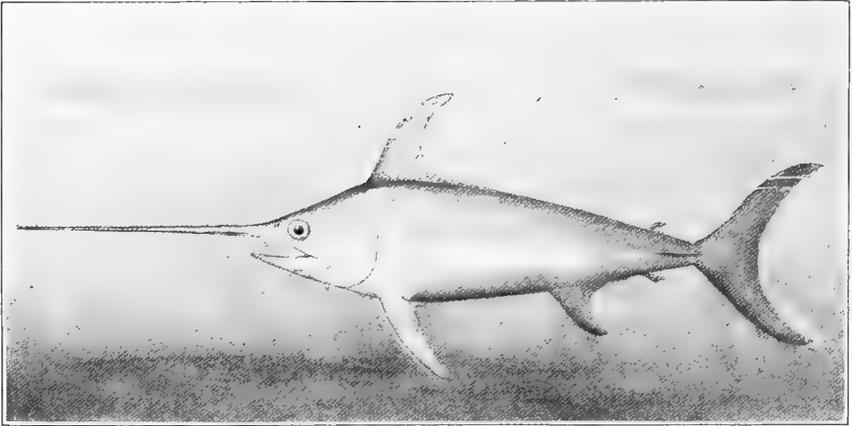
THE SWORDFISH¹ needs neither preface nor introduction, for his sword serves all such purposes.

In the Government museum at Singapore is a three-inch-thick section of copper-sheathed oak plank, cut from the side of a ship, which has sticking through it the sword of a Swordfish. Now, the material of such a sword is by no means so hard that it could by ordinary means be forced through three inches of the hardest kind of oak planking sheathed with copper. The fact of clean penetration implies a speed of not less than sixty miles per hour, and perhaps more. With such locomotive powers, and such a weapon for slaughter, it is fortunate that its owner has not been

¹ *Xiph'i-as glad'i-us*. The pronunciation of the generic name is Zif'e-as.

fitted out with the teeth and appetite of a killer, else the cetaceans would soon be exterminated.

The Swordfish well understands the offensive and defensive value of his sword, and there are on record many well-authenticated instances wherein this pugnacious creature has driven its formidable weapon through the sides or bottoms



THE SWORDFISH.

of small boats, to the peril of the occupants. The majority of such incidents have occurred to boats regularly engaged in swordfishing, which is a noteworthy industry on our Atlantic coast.

Broken swords have been found in the sides and bottoms of quite a number of ships. In 1871 the fishing yacht *Red-hot*, of New Bedford, was pierced and sunk by a Swordfish which had been hauled alongside to be killed. In 1875 a Swordfish drove its sword through the bottom of a fishing schooner off Fire Island, and stuck fast. Before the fish had time to free itself by breaking off its sword the fishermen

cast ropes about it and secured it. Its length was over 11 feet, its weight 390 pounds, and the length of its sword 3 feet 7 inches.

The Swordfish is a food fish of very good standing in New England, where it is sliced and salted, and widely esteemed. In 1898 the total catch was 1,617,331 pounds, valued at \$90,130. For the year 1913 the output was 1,809,840 pounds, valued at \$162,699.

The food of this fish consists of menhaden, mackerel, bonitoes, bluefish, herring, whiting and squids.

Under the auspices of the famous Tuna Club of Santa Catalina Island, California, the Swordfish has been given a permanent place in the ranks of the big game of the sea, and its place in the club book is next to that of the great leaping tuna. The conditions governing its capture on a sportsman's basis are the same as those governing the chase of the tuna, and up to this date (1914) the highest records are as follows:

W. C. Boschen, New York, 1913	355 pounds
C. G. Conn, Elkhart, Indiana, 1909	334 pounds
L. G. Murphy, Converse, Indiana, 1912	318 pounds
John E. Stearns, Los Angeles, California, 1910	242 pounds

In the ethics of sportsmanship, the anglers of America are miles ahead of the men who handle the rifle and shotgun in the hunting-field. Will the hunters ever catch up?

The anglers have steadily diminished the weight of the rod and the size of the line; and they have prohibited the use of gang hooks and nets. In this respect the initiative of the Tuna Club of Santa Catalina is worthy of the highest

admiration. Even though the leaping tuna, the jewfish and the Swordfish are big and powerful, the club has elected to raise the standard of sportsmanship by making captures more difficult than ever before. A higher degree of skill and nerve and judgment is required in the angler who would make good on a big fish; and, incidentally, the fish has about double "the show" that it had fifteen years ago.

That is sportsmanship!

But how is it with the men who handle the shotgun and the rifle?

By them the Tuna Club's high-class principle has been exactly reversed! In the making of fishing-rods, commercialism plays small part; but in about forty cases out of every fifty the making of guns is solely a matter of dollars and profits. The range and general deadliness of sporting firearms have been increased to the limit of human ingenuity, and to-day the most popular shotguns in America are those that are most unfair to the game—the "automatic" and the "pump-gun." However, a very few sportsmen are beginning to use shotguns of extra small calibre; and this is true sportsmanship.

THE SUCKING FISH, or REMORA,¹ is a high-class parasite, who does much of his travelling at the expense of sharks who would eat him if they could. In one of her odd freaks of merry-making Nature fashioned on this creature's head a large, flat disk, set crosswise with rows of delicate spines, all pointing backward. It is really a peculiar development of

¹ *Re-mo'ra bra-chyp'ter-a*. See figure on page 309, of an individual attached to a mackerel shark

the first dorsal fin. When the Sucking Fish desires to travel and see the sea-world, it hunts up the nearest shark, swims alongside from the rear, claps its head to the shark's side, and sticks fast. The faster the shark glides through the water, the more tightly clings the automatic tramp. Like a passenger in a Pullman sleeping-car, the Remora can bid the world good-night and go to sleep, serenely confident that he will get on in the world, even while he sleeps. It is as if a human tramp were provided by Nature with means enabling him to cling automatically and comfortably to the side of a moving freight-car, instead of walking in dust and sorrow upon the ties.

The Remora is not a large fish, its usual length being under 2 feet. Not only is it a parasite of sharks and other large fishes, but it attaches itself to the sides of ships. It is said that sometimes sharks actually become emaciated through prolonged labor in furnishing free transportation for lusty Remoras. The parasite is himself a good swimmer, and the best reason assignable for its strange habit in clinging to sharks is its desire to gather in fragments of the feast when the latter makes an important killing. The Remora is an inhabitant of our Atlantic coast, the Gulf of Mexico, and the West Indies generally, but it is not considered a food fish.

CHAPTER L

ORDER OF PIKES

HAPLOMI

AFTER the Order of Spiny-Finned Fishes, with its great array of genera and species, it is a relief to reach an Order which contains but one Family, and only five species. The so-called Yellow "Pike" is not a member of this aristocratic and exclusive Family; for, as already stated, it is only a pike-perch.

Look at any member of the Pike Family, and tell me whether it does not make you think of a pirate. Observe that yawning sepulchre of a mouth, that evil eye and low, flat forehead—all indicating a character replete with cunning and ferocity. Note the total absence of a dignified and respectable *front dorsal fin*, which nearly every fish of proper moral character possesses and displays with pride.

Like scaly assassins, the pikes and pickerels lie in wait for their prey; and whenever one rushes like a green streak from under the lily-pads, and bolts a trolling spoon in one great, ill-mannered gulp, the angler feels a savage delight in thinking that it serves him right. These fishes are the most voracious creatures that inhabit our inland waters. Their ambition is to devour every living creature that comes in sight, and they prey upon all other fishes, frogs and am-

phibians generally, ducklings, other small aquatic birds, and also small aquatic mammals. Worse than this, they even devour their own kind. That they are found living with the bass, perch and other fishes is generally due to the fact that it is impossible for them to devour all their neighbors.

THE PIKE¹ is a fish of very wide—almost world-wide—distribution. In America it is found from Kadiak Island, Alaska, southward through British Columbia, Canada, the upper Mississippi Valley and the Great Lakes region, to Europe and Asia. Dr. Jordan says (“Food and Game Fishes”) that it reaches a length of 4 feet, a weight of 40 pounds, and that the Kankakee River, in Illinois, is one of the best streams for great Pike fishing of which he knows. As a food fish the Pike ranks low.

THE MUSKALLUNGE² is a game fish of high rank, and its Indian name is spelled in eight different ways. Its standing may be expressed in the following proportion: *The Muskallunge is to the fresh-water angler as the tuna is to the salt-water angler.*

Its great size makes it a great prize, and the taking of a large fish with sportsman-like tackle, and a very good chance to be upset in deep water during the struggle, makes the Muskallunge the king of fresh-water game fishes. The northern species—of the Great Lakes, the St. Lawrence and southern Canada—reaches a length of 7½ feet, or more, and attains a maximum weight of about 90 pounds. Its centre of abundance seems to be in the Thousand Islands of the St. Lawrence, where it affords grand sport. Usually it is caught

¹ *E'sox lu'ci-us.*

² *E'sox mas-quin-on'gy.*

by trolling—a most delightful scheme by which the twin pleasures of boating and fishing are combined.

THE CHAUTAUQUA MUSKALLUNGE¹ is a species quite distinct from its more northern relative. It is confined to



THE MUSKALLUNGE.

Chautauqua Lake and a few localities in the Ohio Valley—a comparatively small area. In that landlocked region, far from the shad and the bluefish, it is by many persons considered a fine fish for the table.

THE CHAIN PICKEREL² is so common throughout the region bounded by Maine, Florida, Arkansas and Minnesota that it is difficult to say where it is not found. It is so well and so widely known that it requires neither introduction nor description. On the lovely lakes of central

¹ *E'sox o-hi-en'sis*.

² *E'sox re-tic-u-la'tus*.

Michigan and New York, to stand up in a boat that is properly handled, and throw a trolling spoon along the borders of the lily-pad archipelagoes, where the Pickerel hide, is good sport. In the crystal-clear water the whirling, glittering spoon is in sight every moment, and you can see the rush of the Pickerel when he flies straight as an arrow at the lure. This fish is so voracious that several kinds of bait are effective for it; but I see no reason for calling its flesh a delicacy. Its maximum size is about 28 inches, which is considerably larger than the little *Brook Pickerel* of the northern Mississippi Valley.

CHAPTER LI

ORDER OF TROUT AND SALMON

ISOSPONDYLI

THIS grand Order is represented in North American waters by 135 full species of fishes, all decidedly edible, and the majority of them are classed as "game" fishes. It includes not only some of the most choice of all our finny tribes, but also others whose commercial value is of the highest rank. In it are found the trout, salmon, whitefish, shad, herring, menhaden and tarpon. Despite the great number of species in the Spiny-Finned Order (446), it seems highly probable that their combined value in the markets falls far below the aggregate for the Order now under consideration. In 1913 the value of the annual salmon catch of Alaska alone was \$14,448,234, whereas the annual value of the cod, the most valuable food fish of the Atlantic, was only \$2,031,744.

Reminding the reader once more that we are endeavoring to present groups in the order of their natural rank and importance, we present first in this Order of fishes the Family of highest interest and value.

THE SALMON FAMILY

Sal-mon'i-dae

The Salmon Family contains all the trout, salmon and whitefishes, to the number of thirty-two full species and

twenty-nine subspecies. Of these three groups, the first is celebrated for the beauty of form, picturesque surroundings, and gamy qualities of its members. The salmon and whitefish are noted chiefly for their great value as food.

Few persons, it is safe to say, know either the size or the subdivisions of the group of American trout and charrs. The species are numerous, beautiful and widely distributed north of a line drawn from New York City to San Diego, California. For a clear and correct understanding of these fishes, a diagram is absolutely necessary. The world is indebted to Dr. D. S. Jordan for the researches which have made him the leading authority on this large and extremely interesting group of fishes, and by means of which it has been made comprehensible.

Of North American trout, generally, the centre of abundance is certainly west of the Rocky Mountains, and the group as a whole is decidedly of the Far West. The trout of the eastern United States are but the advance guard of the main body which fills the swirling mountain streams and lakes of the Rocky Mountain region and the Pacific coast. Our famous and well-beloved speckled trout of the East is but a trifling incident in comparison with the many fine species found in the true home of the Trout Family.

Dr. Jordan believes that our original stock of trout came to us from Asia, and "extended its range southward to the upper Columbia, thence over the continental divide via Two-Ocean Pass to the Yellowstone and the Missouri Rivers, the Platte, Arkansas, Rio Grande and Colorado." He actually caught Yellowstone trout in Two-Ocean Pass, on the top of

the great continental divide, "in the very act of going from Pacific into Atlantic drainage."

SUBDIVISIONS OF THE NORTH AMERICAN TROUT AND CHARRS

(Species in italics are introduced in the text)

WESTERN TROUT:	}	Mountain Trout Group:	{	<i>Mountain Trout.</i> Yellowstone Trout. Silver Trout. Lake Tahoe Trout. Truckee Trout. Utah Trout. Jordan's Trout and seven others.
		Rainbow Trout Group:	{	<i>Rainbow Trout.</i> McCloud River R. Trout. Kern River R. Trout. Golden Trout. Stone's Trout.
		Steelhead Trout Group:	{	<i>Steelhead Trout.</i> Speckled Steelhead Trout. Kamloops Trout. Blueback Trout.
LAKE TROUT (of the Great Lakes):	}	.....	{	<i>Lake Trout.</i> Siscowet Trout.
EASTERN TROUT AND CHARRS:	}	.....	{	<i>Brook Trout.</i> Dolly Varden Trout. Sunapee Trout. Blueback Trout. Marston Trout, and others.

THE MOUNTAIN TROUT, or BLACK-SPOTTED TROUT.¹—

Like many others, this is a fish of many names—Spotted, Black, Silver, Salmon, Steelhead and Cut-Throat—all ending with Trout. The last mentioned—"Cut-Throat Trout"—Dr. G. Brown Goode characterized as "a horrible name,

¹ *Sal'mo clark'ii.*

which it is hoped will never be sanctioned in literature." And why "Cut-Throat," any more than Ripper Trout, or Wife-Beater Trout?

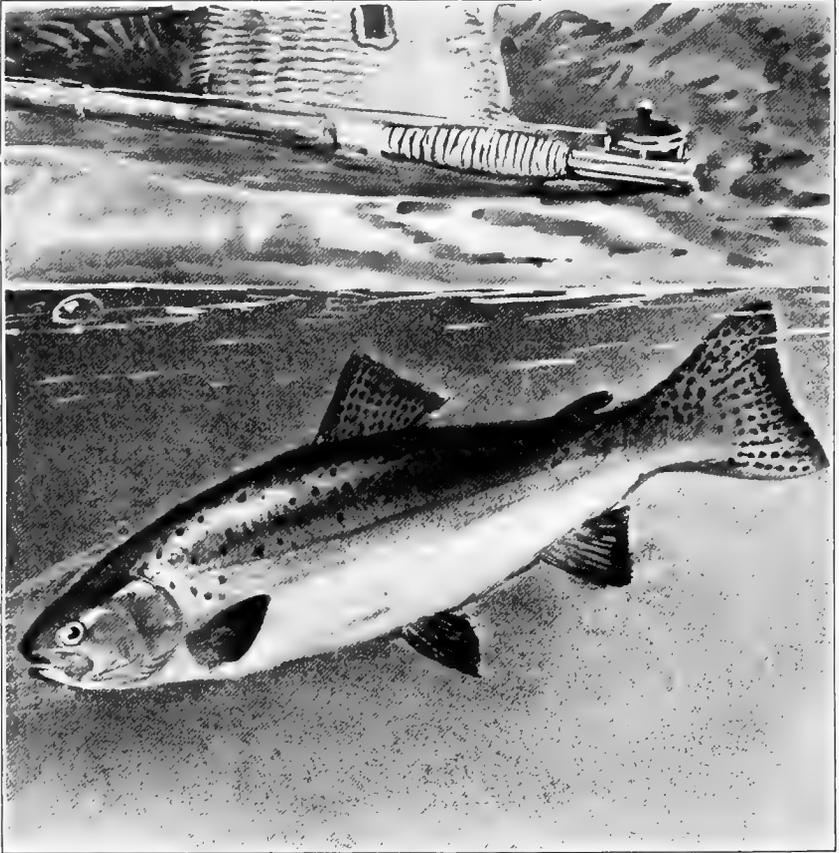
Surely this fine fish, which Dr. Jordan considers probably the parent from which all others of this group have been derived, is worthy of a dignified and respectable name. It is a fish of large size, attaining a length of 3 feet, and a weight of 30 pounds. It is *the* fish of the Rocky Mountain region, and occurs in nearly every lake and important stream of Montana, Wyoming, Utah, Colorado, New Mexico, Idaho, Oregon, Washington and northern California. It reaches the sea from Mount Shasta northward to Puget Sound and beyond: "Those that live in the depths of shady lakes are almost black, while others are pale. Those in the sea are silvery, or only faintly spotted." (G. Brown Goode.)

In the most representative specimens of this species, the upper half of the body is abundantly spotted with small, round and rather regular black spots.

THE RAINBOW TROUT¹ is a fish of real beauty, comfortable size, fine flavor, and easy to propagate artificially. On this side of the Rocky Mountains, however, it is not politic to assert that it is more beautiful than the brook trout; but Dr. Jordan says that "by many anglers it is regarded as the greatest of all game fishes." It "reaches a weight of half a pound to 5 or 6 pounds, though in most of the streams in which it is found it rarely exceeds 2 or 3 pounds." It bites readily, but when hooked makes a gallant fight to escape, rushing, leaping and shaking its head vigorously to expel the barb.

¹ *Sal'mo ir-id'e-us.*

In appearance, this typical Rainbow Trout is like an elegant little salmon from 15 to 18 inches long, with spots along



RAINBOW TROUT.

its upper body like those of the eastern brook trout, and sides like a section of a rainbow. It is found only in the small brooks of the coast ranges of California, from Klamath River to San Diego. It takes a fly with a degree of readiness

which "will please the most impatient of inexperienced amateurs."

The group of Rainbow Trout contains six species, all told, the others being the *Western Oregon Brook Trout*; the *McCloud River Rainbow Trout*, which is the species propagated by the United States Bureau of Fisheries; the *Kern River Trout*; *Golden Trout* of Mt. Whitney and Kern River, which Dr. Jordan considers the most beautiful of all, and *Stone's Trout*. All these species are found only along the Pacific coast, between Washington and southern California.

THE STEELHEAD TROUT,¹ and its group.—The fish which represents this group is of commanding size, and of high value as a food fish. Its other names are SALMON TROUT and HARD-HEAD. It reaches a maximum weight of 14 pounds, but usually its weight is between 5 and 8 pounds. It "ranks very high as a game fish, and trolling for Steelheads in the bays, sounds and river mouths along our Pacific coast affords excitement and pleasure exceeded among the *Salmonidae* only by trolling for Chinook Salmon." (Jordan and Evermann.)

This fish is regularly propagated by the United States Bureau of Fisheries, by which it has been successfully planted in Lake Superior. Great numbers are caught every year in the Columbia River and canned for the eastern markets. It is found in the streams flowing into the sea along the coast of California, from southern California to Alaska. Its scales are small, its form is salmon-like, and its color is silvery, with a wash of rose-pink down the sides.

¹ *Sal'mo gaird'ner-i*.

THE GREAT LAKE TROUT, or MACKINAW TROUT,¹ and its group.—This fish is the largest of all trout. Its usual weight is from 15 to 20 pounds, but it reaches a maximum of 125 pounds. Its color is dark gray, varying most erratically from pale gray to almost black. Its irregular and very numerous spots of gray mark this fish very distinctly, for they cover not only the body but all the fins save those under the body.

As its name implies, this is essentially a fish of the Great Lakes, and for many years has been the principal source of fresh-fish supply for a large area in that region. In its own field its only rival in commercial importance is the whitefish. Usually the flesh of the latter is supposed to be a greater delicacy than the other.

The Lake Trout has passed through two or three very interesting periods. From 1880 to 1886 commercial fishing for Lake Trout was carried on so persistently that the supply showed alarming signs of exhaustion. Here the United States Bureau of Fisheries stepped in, and along with state hatcheries began to propagate and distribute this species. This work was continued until many millions of fish-eggs had been planted in the lakes. After that the supply of Lake Trout increased so rapidly that presently the markets were overstocked, and the price dropped accordingly.

More recently, however, the pendulum has swung the other way. All around the Great Lakes the demand for food fishes is now so great and so permanent that the natural supply has proven unable to meet it. Nature cannot produce food fishes in the lakes in the enormous quantities required,

¹ *Cris-ti-vo'mer nam'ay-cush.*

even though in 1899 the yield of Lake Trout was ten million pounds (10,611,588). To-day the United States Bureau of Fisheries is doing its utmost to help maintain the supply, and in 1913 distributed 30,231,524 eggs and young of the Lake Trout.

“Lake Trout spawn on the reefs, and at other times live in deep water. In Lake Superior the spawning season begins in late September. In Lakes Huron and Michigan, the height of the season is early November, and spawning continues until December. The spawning-grounds are on the reefs of ‘honey-comb’ rock, 10 to 15 miles off shore, and in water from 6 to 120 feet deep. The number of eggs produced is not large. A 24-pound fish produced 14,943 eggs, but the usual number does not exceed 5,000 or 6,000.” (Jordan and Evermann.)

The range of this fish is from New Brunswick and Maine westward throughout the Great Lakes to Vancouver Island, B. C., and northward to Labrador, Hudson Bay, and northern Alaska.

DEEP-WATER FISHING FOR LAKE TROUT.—“The Sisco-wet of Lake Superior is taken by the commercial fishermen in very deep water, the nets being lifted by steam-power. The nets are set well out toward the centre of the lake, at depths frequently as great as 500 feet. About forty nets, each over 600 feet long, are set in one ‘gang,’ constituting practically a single gill-net considerably over four miles in length. Each end of each gang is buoyed.

“The average steam fishing-boat attends to five gangs of nets, lifting one each day. Each gang, therefore, remains

in the water five days before it is lifted. As the net comes up around the steam windlass forward, it is passed aft and immediately reset by being paid out over the stern by two members of the crew. The nets are about eight feet wide, and the mesh is four and half inches.

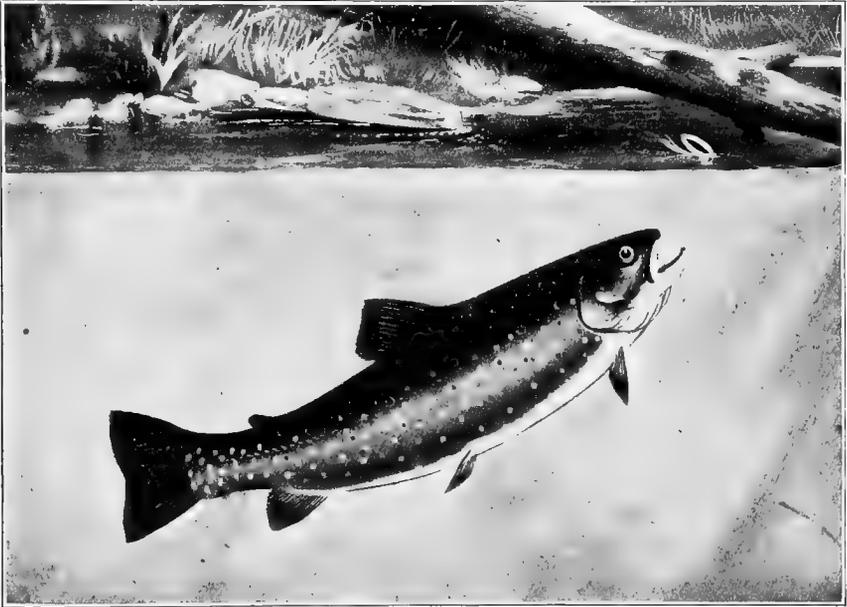
“The largest Lake Trout I observed on the *Currie* was 2 feet 10 inches long, and its weight was 21 pounds. The average length of the fishes taken during my inspection was less than 2 feet.” (Charles H. Townsend.)

THE BROOK TROUT, or SPECKLED TROUT, and its group.— Concerning this beautiful and high-spirited creature so much has been written it would now seem that there is nothing untold. But this is a very wide country; and I ween that in the real West there may be a million of good citizens who are strangers yet to *Sal-ve-li'nus fon-ti-nal'is*.

After all has been said, I think it must be conceded that this is the most beautiful of all our game fishes. Its back and dorsal fins are elegantly marbled, its sides have about fifteen or twenty crimson and black spots, and its pectoral, ventral and anal fins are bright crimson, edged in front with white. Its general ground-color down to the latitude of the pectoral fin is dark olive, below that comes sunset pink and underneath all is the silver white of the belly.

Along with its beauty, agility and general gameness, this fish makes its home in the most picturesque and beautiful streams its range affords. Its ideal haunt is a deep, clear pool at the foot of a picturesque rush of water over mossy bowlders. Usually this forest jewel is delightfully set in the foliage of overhanging birches, beeches and maples, and

well backed by the forest shadows that painters love. Usually the music of rushing water pervades the haunt of the Brook Trout; and the only cloud upon it all is that, ever and anon, Man, the supposedly high-minded, savagely bends



THE EASTERN BROOK TROUT.

every energy to kill an unduly great number of these beautiful creatures, and fills a sordid creel entirely too full.

Most unluckily for the Trout, it is its habit to be ever on the alert for insects on the surface of its pool, and "rise to a fly." To the high-class sportsman who scorns the humble angle-worm, the accurate throwing of a small fly for a very long distance, solely by the exercise of great skill and judgment, is the crowning attraction in seeking the Brook Trout

in its haunts. The skill required in fly-fishing is enough to tempt any man who has ever felt the electricity with which every good fly-rod is charged; and it is no wonder that men love to fish for this very beautiful fish in the most charming of all sylvan situations.

The Brook Trout was once a habitant of the northeastern United States, northward of a line drawn from New Jersey to Minnesota, into Labrador, Canada and Manitoba; but to-day where is it? Ask the "fish-hog" who spares no Trout that is big enough to lift from a platter. Ask the market fishers, who fish and fish to supply hotels and restaurants, in season and out of season.

In its wild state this fish is doomed to disappear at an early date. We have now in this country a large and rapidly increasing element the members of which have come to us to slay and eat. To them, the preservation of wild life *to look at* seems like childish folly. These, and others like-minded, are raking our trout-streams with fine-toothed combs, and mean that nothing larger than a trout-egg shall escape. And the end will be that in a very few years the wild Brook Trout will be as nearly extinct as the wild buffalo.

THE SALMON GROUP

The salmon were made for the millions. The Siwash Indian eats them fresh in summer, dries them, and later on freezes them, for himself and his dogs in winter. The epicure pays for having the fresh fish shipped in ice to his table, wherever that table may happen to be. In mid-ocean the great American canned salmon is often the best and only fish

afloat. In the jungles of the Far East, in the frontier bazaar of the enterprising Chinese trader, it "bobs up serenely" to greet and cheer the lonesome white man who is far from home and meat-markets. Even in the wilds of Borneo its name is known and respected; and he who goes beyond the last empty salmon tin truly goes beyond the pale of civilization. The diffusion of knowledge among men is not much greater than the diffusion of canned salmon; and the farther Americans travel from home, the more they rejoice that it follows the flag.

The salmon species of North America are as follows:

AMERICAN SALMON.	}	ATLANTIC	}	Atlantic Salmon.
		Species:		(Of Europe and North America.)
				Ouananiche.
				(The leaping fighter.)
				Sebago.
				Quinnat, or Chinook.
				(Most valuable species.)
				Blueback, or Sockeye.
				(Second in value.)
		PACIFIC	}	Silver, or Coho.
		Species:		(Third; flesh white.)
				Humpback, or Gorbusha.
				(Of little value.)
				Dog, or Kayko.
				(Of least value.)

The common salmon of Europe, and also of Labrador and New England, was accounted a wonderful fish, both for sport and for the table, until the discovery of the salmon millions of the Pacific coast effectually cheapened the name. To hold their place in the hearts of sportsmen, game fishes positively must not inhabit streams so thickly that they are

crowded for room and can be caught with pitchforks. Yet this once was true of the salmon in several streams of the Pacific coast. The bears of Alaska grow big and fat on the salmon which they catch with the hooks that Nature gave them.

The five species of Pacific salmon form a remarkable group. They lead all fishes in annual commercial value; they are the most abundant of all fishes that inhabit fresh water; they traverse very great distances to reach their spawning-beds, and they all die immediately after spawning!

The sea is the home of all the Pacific salmon, and except when the young are floating toward it from their birthplace, it contains their food. Of their life in the sea little is known. They are nowhere numerous, and trolling for them in salt water is interesting sport.

Throughout the months of spring and summer the salmon leave the sea, enter the large rivers—and many small ones, also—and proceed upward for hundreds of miles, to deposit their eggs as far as possible from salt water. In the Columbia and Yukon Rivers, and their tributaries, it “is the habit of salmon to ascend for *a thousand miles* or more before spawning!”

The “run” begins with the advent of spring, when the salmon travel up the rivers until they can ascend no farther. It is on these runs that the fish congregate in such incredible numbers that sometimes they actually crowd each other, and can be photographed *en masse*. They rush up rapids, and if cascades or low water-falls are encountered, they leap atop of them with a display of energy and activity that is, when first heard of, almost beyond belief.

“When the Pacific salmon reach maturity,” says Mr. Cloudsley Rutter, in *Country Life*, “they seek fresh water to spawn. As soon as they leave their accustomed salt-water food, they stop eating. It is not uncommon for fishes of the Salmon Family to fast during the breeding-season, but the Pacific salmons never taste food after leaving salt water, and their fast ends only with death. This is true of all species of Pacific salmons, and is without a parallel among the higher fishes.

“As the salmon advances into fresh water, the digestive organs shrivel to one-tenth their natural size, all the fat disappears from the tissues, the flesh turns white, and the skin thickens and embeds the scales till they cannot be seen. By the time spawning begins the fish has lost about twenty per cent of its weight, and sometimes much more. In fresh water, the jaws of the males become much prolonged and hooked, and large canine teeth appear. The body becomes deep and slab-sided; and the skin turns reddish in most species. No individual of either sex of any species of Pacific Salmon ever returns to the ocean after spawning.”

Concerning the Chinook salmon, Drs. Jordan and Evermann say that the run begins in the Columbia River as early as February or March. The fish move up without feeding, travel leisurely at first, but as they advance farther they move more rapidly. Many of them pause not until they have found satisfactory spawning-beds in the Snake and Salmon Rivers, among the Sawtooth Mountains of Idaho, more than 1,000 miles from the sea. “Those which go to the headwaters of the Snake River spawn in August and early

September; those going to the Big Sandy in Oregon, in July and early August; those going up the Snake to Salmon Falls, in October; while those entering the lower tributaries of the Columbia, or small coastal streams, spawn even as late as December."

"The spawning extends over several days, the eggs being deposited upon beds of fine gravel, in clear, cold mountain streams." The temperature of the water must be about 54°, and if on arrival it is much above that, the fish wait until it lowers. ("American Food and Game-Fishes.")

A very remarkable feature about the spawning of the salmon is that after it is completed both males and females *die!* "This," say Jordan and Evermann, "is true of all, whether spawning remote from salt water, or only a few miles, or yards, from the sea," and whatever the cause may be, it "is general in its application to all the Pacific coast salmon."

Inasmuch as the bodies of many dead salmon show injuries of many kinds, the belief has become prevalent that the fish injure themselves by striking against rocks on the run upstream, and ultimately die from wounds so received. But the investigations of Drs. Jordan and Evermann have completely disproved this. It was found that of the many salmon examined immediately after arrival on their spawning-grounds in central Idaho, not one showed any bruises or mutilations, and all were in excellent condition. The mutilations which subsequently were observed were obtained either by fighting, or by pushing the gravel about on the spawning-beds.

Salmon eggs hatch in about fifty days. During the first six weeks the egg-sac supports the life of the alevin, which

lives quietly on the spawning-bed. By the end of six weeks the yolk-sac is absorbed, and the young fry begins to float down-stream toward the sea. When the journey is very long, the trip occupies several months, or even a year; and when the young salmon at last reaches salt water, it is 4 or 5 inches long, and is known as a "parr." Of course the young salmon feed all the way down, on a fresh-water menu.

Naturally, the salmon millions of the Pacific streams early attracted the attention and aroused the avarice of men who exploit the products of Nature for gain. As usual, the bountiful supply begat prodigality and wastefulness. The streams nearest to San Francisco were the first to be depleted by reckless over-fishing, and now some of the fishermen of California solemnly aver that the sea-lions are largely to blame for the depletion of the Sacramento salmon fishery! It is the rapacious and deadly net and salmon-wheel, not the squid-eating sea-lion, that is to blame. Regarding the conditions that in 1901 prevailed in Alaska, the following notes by Mr. George Bird Grinnell in the "Harriman Alaska Expedition" are of interest:

"The salmon of Alaska, numerous as they have been and in some places still are, are being destroyed at so wholesale a rate that before long the canning industry must cease to be profitable, and the capital put into the canneries must cease to yield any return.

"The destruction of salmon comes about through the competition between the various canneries. Their greed is so great that each strives to catch all the fish there are, and all at one time, in order that its rivals may secure as few as

possible. . . . Not only are salmon taken by the steamer load, but in addition millions of other food fish are captured, killed and thrown away. At times, also, it happens that far greater numbers of salmon are caught than can be used before they spoil. A friend of mine told me of the throwing away of 60,000 salmon at one time, near a cannery in Prince William Sound, in 1900; and again the similar throwing away of 10,000 fish. So something like 700,000 pounds of valuable fish were wasted."

In the Kadiak and Chignik districts, the catch of salmon decreased from 360,000 cases in 1896 to 90,000 in 1898, and in 1899 it was almost a failure. In many of the small Alaskan streams the canning companies built dams or barricades to *prevent the fish from ascending to their spawning-beds*, and to catch all of them! In some of the small lakes the fishermen actually haul their seines on the spawning-grounds.

In the first edition of this work (1903) we recorded a warning of the impending destruction of the Alaska salmon industry, and demanded strict governmental regulation.

It is now a pleasure to be able to state that notwithstanding the enormous annual drain upon them, and the reckless and wasteful methods of fishing that once prevailed, the salmon fisheries of Alaska are still holding up remarkably well. Ten years ago there were grounds for grave apprehension regarding the future salmon supply of Alaska, but Congress placed those fisheries under the control of the United States Commissioner of Fisheries, giving him arbitrary power to close against the fishermen any stream or streams that seemed to be in danger of exhaustion.

To-day (1914) the supply of Alaskan salmon seems to be well sustained. The total catch for the season of 1912-13 was 3,739,185 cases, 38,332 barrels, and 7,656,205 pounds, having a total cash value of \$14,448,234. In 1911 the total number of salmon caught was "over 43,975,000 fish," which in view of the average size of Alaskan salmon fairly challenges the imagination. The catch of 1913 was the largest ever taken in Alaska. It should also be noted that in 1911 five private salmon-hatcheries took a total of 276,363,500 eggs, for propagating, of the red, humpbacked and silver salmon.

In 1912 there were 64 salmon canneries in Alaska, employing 17,900 persons, and representing \$22,671,000 of invested capital. It seems reasonably certain that the successful preservation of the industry is due to the intelligent and thorough governmental supervision that has been established since 1904, superseding the "wide-open" situation that existed at that time. Unfortunately, our Pacific coast fisheries are not in an equally prosperous condition.

THE QUINNAT SALMON,¹ also called *Chinook*, *California*, *King*, *Columbia River* and *Sacramento Salmon*, is the largest, the most widely distributed and the most valuable of the Pacific Salmon. Frequently it attains a weight of 50 pounds, and specimens have been taken in Alaskan waters weighing about 100 pounds. Its average weight is between 20 and 30 pounds. It is found from Monterey Bay, California, up the

¹The scientific name of this fish, *On-co-rhyn'chus tsha-wyts'cha*, is presented with an apology to the reader. The specific name is useful only as an example of the disgusting barbarism to which an ill-balanced mind can sometimes descend in choosing names.

whole Pacific coast to Bering Strait, and down the Asiatic coast to China. In 1912 there were landed at Seattle 2,664,066 pounds of "King Salmon," valued at \$234,075.



THE QUINNAT SALMON.

THE BLUEBACK SALMON,¹ also called *Sockeye*, *Nerka*, *Redfish* or *Red Salmon*, is the most abundant species, and in flavor and general importance it stands next to the preceding. In Alaska it is of greater value than all other species combined. Its flesh is of a rich red color, full of oil and of

¹ *On-co-rhyn'chus ner'ka*.

fine flavor. In size it is small for a salmon, its average weight being only about 5 pounds. Its geographic range is from the Columbia River to Japan, and it is the species most abundant in the canneries along the Fraser River and the shores of Puget Sound. In 1912 the catch of Sockeye or Red Salmon landed at Seattle amounted to 7,724,652 pounds, valued at \$853,127.

The *Little Red Fish* of various lakes in Idaho, Oregon and Washington, wherein they reside continuously, are now regarded by Dr. Jordan as small and immature specimens of the Blueback Salmon. Like all others of their genus, they die immediately after spawning, sometimes bearing body bruises, and again quite free from them.

In Alaska the abundance of the Blueback is almost beyond belief. A catch of 10,000 fish at one haul is of common occurrence; 25,000 at a haul is not uncommon, and 50,000 are taken at least once every year. The record haul was made in 1896, when about 100,000 were taken, of which 60,000 were used and the remainder liberated. (Cloudsley Rutter.)

THE SILVER SALMON¹ stands third in the list. Its other names are *Kisutch*, *Hoopid*, *Skowitz*, *Coho Salmon*, and "*White Fish*."

The range of this fish is from California to Japan. It is next in size to the quinnat, but inferior in flavor, and its flesh is pale. It is a good fish to ship fresh, and despite the fact that when canned it is not highly esteemed, great quantities are canned in Oregon and Washington, and marketed as

¹ *O. ki'sutch*.

“medium-red Salmon.” In 1911 the number of pounds “landed at Seattle” was 2,117,265, valued at \$117,130.

THE HUMPBACK SALMON,¹ also called the *Gorbuscha*, *Holia*, *Hone* and *Haddoh* Salmon, ranges from the Sacramento to Kamchatka. It derives its best name from the fact that “upon the approach of the breeding-season the back of the male grows higher than it usually is, and forms an abrupt hump back of the head,” at which time the flesh is valueless.

Formerly this fish was not highly regarded by the canning establishments, and was but little used. To-day it is receiving its full share of attention from the canning establishments, and is now quite on the market. Its place now and in the future is clearly indicated by the fact that, in twelve months of 1912-13, 10,657,233 pounds of Humpback Salmon, worth \$686,013, were “landed at Seattle” alone.

THE DOG SALMON² is the least valuable of the Pacific Salmon. Its flesh is of such poor flavor that formerly it was ignored by the canners. Now, however, it is being put up under various names that are not its own, such as “Chum Salmon.” This fish is also called *Hayho*, *Lekai*, *Qualoh* and *Calico* Salmon. Its range is from Sacramento to Kamchatka; and in the rivers of Japan it is the most common species. Its weight is from 10 to 12 pounds. In the season of 1912 the product of Dog Salmon landed at Seattle amounted to 7,313,345 pounds, valued at \$322,599.

As previously observed, the Salmon of the Pacific coast far surpass in commercial value all other American fishes.

¹ *On-co-rhyn'chus gor-bus'cha*.

² *O. ke'ta*.

Their accessibility renders their capture little more than a mechanical operation, and eventually it will result in the practical destruction of the salmon industry. Americans seem utterly unable to conserve for perpetual benefit any particularly valuable form of wild life.

A brief comparison of the value of the Alaska salmon industry fifteen years ago and now shows that in 1899 the product was valued at \$6,773,876, and in 1913 it amounted to \$14,448,234.

THE ATLANTIC COAST SALMON.—It is now necessary to call this fish the ATLANTIC SALMON¹ in order to distinguish it from the Pacific species; but for two centuries it held its place in literature as *the* Salmon. It once inhabited many portions of northwestern Europe, and in some it still survives.

In North America its natural habitat was originally from the mouth of the Hudson River northward throughout the coastal rivers of New England, Canada, New Brunswick, Nova Scotia, Newfoundland, and Labrador, to Greenland. Once very abundant in the Connecticut River, it was driven out of that stream in 1798 by the erection of a sixteen-foot dam in Miller's River, 100 miles from the sea, which cut off the fish from their spawning-beds. In 1872 there were twenty-eight rivers in the United States which once contained Salmon, but from twenty of them that fish had totally disappeared. To-day the nearest Atlantic Salmon are found in Maine and northern New Hampshire, New Brunswick and Nova Scotia.

As a game fish, *Salmo salar* is fit to rank with the kings

¹ *Sal'mo sa'lar*.

of the animal world. He who catches one with a fifteen-foot rod weighing twenty ounces, with a silver doctor at the end of a five-foot leader, and brings it to the gaff, may well call himself an angler. So far as I know, this is the largest fish that rises to a fly.

The greatest weight on record for the Atlantic Salmon is 83 pounds. The maximum weight of those now taken in Maine is about 25 pounds, and the average is about 10 pounds. In 1900 the catch of the Bangor anglers in Penobscot Pool was 67 fish, weighing 970 pounds. The largest weighed $23\frac{1}{2}$ pounds, and the average was nearly $14\frac{1}{2}$ pounds.

The most wonderful thing about the Atlantic Salmon is its leaping power, in surmounting water-falls that lie in its course to its spawning-grounds. To a fish of this species, a rock-studded cascade three hundred feet long and thirty feet high, down which the water plunges and tears with murderous speed and violence, is a fine highway, up which it gayly promenades without pause or accident.

But a water-fall, with a perpendicular drop of ten or twelve feet, is a more serious proposition, and requires a special effort. To clear such a barrier, the Salmon makes a rush in the pool below it, leaps out of the water, and if possible lands on the edge of the fall. If he falls short by no more than one or two feet, but strikes the descending torrent squarely head on, so that he is not at once swept down, it is said that by a strong flirt of the tail and a wriggle of the body, the gallant fish actually can force itself on up to the edge of the fall, and over it into the coveted waters of the upper level.

The following graphic description of the leap of the

Salmon is from the pen of Dr. Robert T. Morris, whose opportunities for observing and photographing the scenes he describes have been of the best:¹

“It is a most impressive and inspiring sight to watch the untamed Salmon on a wild river making his display of strength and agility in surmounting a crashing torrent that threatens with instant death anything that dares to approach its mad tumult of waters. A Salmon can make his way upward through a sheer fall of water so long as the water is in a solid mass, but the moment that it becomes admixed with air the white water no longer gives a sufficiently firm hold for the broad caudal fin, and the Salmon must leap entirely over the fall. There are pretty well authenticated instances of Salmon clearing a fall of twenty feet. I have measured leaps to nearly this length on falls where almost every Salmon that flew through the air over the fall fairly took one’s breath away, and they were going up at the rate of three or four to the minute at that. I know of nothing short of watching a house on fire that is of more engaging interest than watching the Salmon throwing themselves over wicked waters. The Salmon must have some advantages, to be sure, for accomplishing their best feats. If the water beneath a fall is much broken with rocks and rapids a fish cannot gain sufficient momentum and velocity for hurling himself far into the air; but given a deep and fairly quiet pool to start from, and the Salmon look more like great birds than like fish as they sail upward. One can sometimes find a place to stand at the edge of a fall, and if he remain quiet for a few moments

¹ *Country Life* magazine, 1903, p. 356.

the Salmon will begin to go through the air over his head in quick succession."

Dr. Morris states that from the Penobscot River, in Maine, to Hudson Bay, Salmon enter almost every river on the coast, but south of the Straits of Belle Isle the sawdust and dams in the streams of the lumber region constitute most serious obstacles to their progress and existence. But "the time is coming when twenty rivers on the Maine coast will have their mills so managed in the interest of the Salmon that they will rival the historical streams of Europe. In Washington County alone there are six rivers that Salmon now ascend every year."

THE OUANANICHE,¹ whose name is of Indian origin, and is pronounced *win-nan-ish'*, is a fresh-water Salmon, dear to the heart of every angler who has ever brought one to gaff.

It is fondly spoken of as the "*Leaping Ouananiche*," and frequently as the *Landlocked Salmon*. It is neither more nor less than a fierce-fighting, fresh-water understudy of the Atlantic salmon, which if not self-restricted to fresh water would hardly be described as an independent species. When first taken from the water, it has "a beautiful peacock-blue" color, which disappears at death, changing to the light-gray back and sides and silvery belly of the Salmon. Although called "landlocked," this fish can, and sometimes does, live in salt water—in the mouth of the Saguenay River, for example.

The Ouananiche is a fish which loves rapids and rushing water as a mountain sheep loves crags and precipices. Be-

¹ *Sal'mo ouan-an-iche'*.

cause of the strenuous life it leads, it is beyond doubt the most vigorous and athletic fish that inhabits our waters.

Says Mr. Eugene McCarthy: "None of the fresh-water fish can equal its fighting powers, and, pound for pound, it will outfight even the salmon. Ouananiche are great smashers of rods and tackle, unless one understands how to play them, especially when they make their numerous high jumps from the water. It is not an exaggeration to state that these jumps will average at least five to six, and frequently will number ten to twelve feet. And such leaps! Two or three feet out of the water, often toward the fisherman, then a rush deep down, a pause, a succession of jerks that would seem to tear the hook loose, a wild rush of varying distance, and a run back, almost to the angler's feet. A fish weighing $3\frac{1}{2}$ or 4 pounds will make a fight lasting ten or fifteen minutes, often longer; and that means hard work for every moment for the fisherman." ("Familiar Fish," p. 126.)

This fish is best taken with a fly, on a rod of from six to eight ounces, with No. 4 or 5 hooks. Its home is in Lake St. John, Province of Quebec, and its tributaries; its outlet, the Saguenay, and no one knows how many of the rivers of southern Quebec that flow into the Gulf of St. Lawrence; and also the rivers of Labrador.

THE SEBAGO SALMON,¹ of Maine, is a strictly fresh-water, or "landlocked," species, which takes its name from Sebago Lake, its type locality. It is essentially a 15-pound fish, with an average in Sebago Lake of from 8 to 10 pounds. Owing to the quiet waters it inhabits, and the powerful tackle

¹ *Sal'mo se-ba'go.*

used in fishing for it, this fish does not manifest the vigor and fighting qualities that have made the ouananiche famous. This species bears to Atlantic salmon and the ouananiche so close a resemblance that it is yet an open question whether the three species should not be merged into one (*Salmo salar*).



Drawn by W. L. Steward.

THE SEBAGO SALMON.

At all events, a picture of the Sebago Salmon might easily, under other names, be made to do duty in representing the other two!

THE TARPON¹ is one of the very few large fishes to which it is proper to apply the word *magnificent*. Either in the water or out, or hanging upon the wall of a dining-room, it is, as its pet names implies, a Silver King, entitled to royal honors. Its enormous scales, its back of royal blue and sides of burnished silver proclaim it at a glance, and in the presence of such external splendor we cease to care whether its flesh is

¹ *Tar'pon at-lan'ti-cus*.

savory or not. How the Romans would have doted upon this fish, had they but lived within its realm!

To-day it is beloved of every American sportsman who can get in touch with it, first because of its imposing personality, and next because of the difficulty in catching it with hook and line. It is taken by rod-and-reel fishing in lagoons, and also by trolling in "the passes" between islands. Its flesh is excellent, and will always hold its place in the markets of the South.

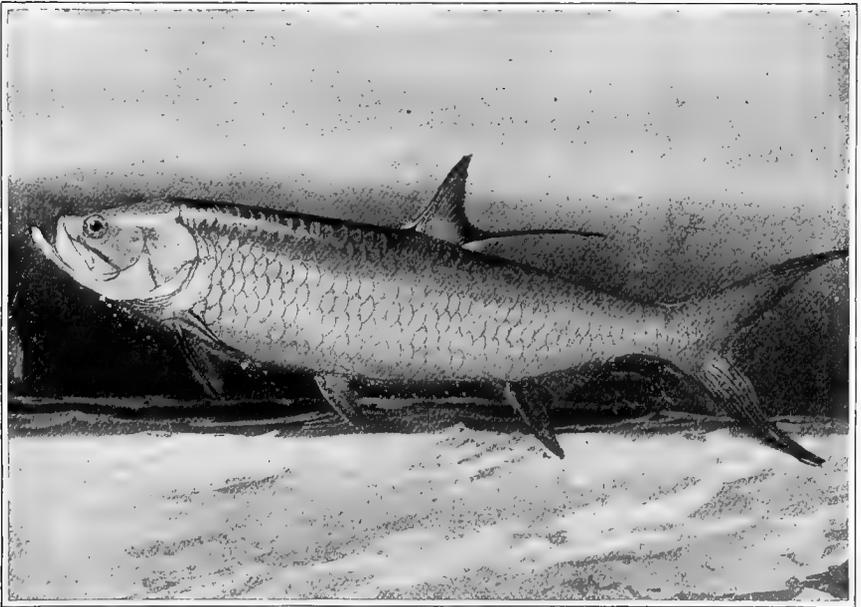
In cruising around the coast of Florida, you first see the Tarpon breaking water, back in air, like an undulating porpoise. You may see fifty of them, and sail and fish for days before you catch one; but one big Silver King pays for a long journey, and ten days of cruising.

Twenty-five years ago no one attempted to catch a 100-pound Tarpon with rod, reel and line of light weight. To-day angling for this grand creature has become an established recreation, and on the Florida coast is regularly pursued as such at Fort Myers, Punta Rassa, Boca Grande Pass, Marco, and Bahia Honda, on the adjacent coast of Cuba. Besides the above, Corpus Christi, Texas, and Tampico, Mexico, have become famous as resorts for Tarpon fishermen.

The size of this fish is entirely satisfactory. Usually its weight is between 100 and 200 pounds, but it is credited with a maximum record of 383. Specimens six feet long are by no means rare.

So far as known on January 1, 1914, the championship of Tarpon angling was then held by Mr. Edward vom Hofe

of New York, with a fish of 210 pounds weight, a length of 6 feet 11 inches, and a girth measurement of 45 inches. Its largest scales measured $3\frac{3}{8}$ by 4 inches. The tackle used in the capture of this fish consisted of a short-butt snakewood



Drawn by J. Carter Beard.

THE TARPON.

rod seven feet long, of which the tip weighed thirteen ounces, a vom Hofe universal reel, 600 feet of No. 24 vom Hofe line, and a No. 1 Van Vleck hook.

The Tarpon is not to be caught in deep water with hook and line. As a rule, the waters of the east coast of Florida are unsuitable for successful adventures with the Silver King; but at several points on the west coast, where the level beach of clear sand shelves far out into the Gulf before it drops

into deep water, this grand fish loves to bask in the sunshine, and linger in the warm, placid waters along the shore, or in land-locked channels and bays.

The Tarpon fisherman goes out early, and casts his bait, half a mullet, upon the shallow waters. For hours he floats upon a sea of molten silver, bathed in a flood of dazzling sunshine, and at times grilling in the heat which comes with it. The clean leap out of water of a big Tarpon firmly hooked is a sight that no sportsman ever can forget. "The Book of the Tarpon," by A. W. Dimock and Julian A. Dimock, is an angling classic in word and picture.

In a few localities Tarpon are really plentiful. The Island of Marco, on the west coast of Florida, is truly an ideal spot for Tarpon. Amid such surroundings as there exist, the sport is irresistible, and the fish are all that an angler could possibly desire.

THE COMMON SHAD¹ is the most savory of all American fishes. It possesses the maximum number of bones to the cubic inch, but its flesh is fine-grained, juicy, and of exquisite flavor. The freshest Shad is "the finest Shad," but when treated with even a show of culinary fairness, every fresh Shad is good.

Like the salmon, the Shad spends half its life in the sea, and enters the rivers of its choice only to spawn. Owing to the practical impossibility of taking Shad in the ocean, the shad-fishing season is limited to its spawning season. This is one of the most prolific of our fishes, a single fish sometimes yielding 150,000 eggs. It is easily propagated by artificial

¹ *Al-o'sa sap-i-dis'si-ma.*

means, but the present decrease in the annual supply cannot be made good solely by the hatcheries of the United States Bureau of Fisheries. During the spring of 1900, the agents of that Bureau planted 291,056,000 young Shad and eggs in the rivers of the Atlantic coast that are accepted by the species as breeding-grounds, but in 1913 the number of eggs and young fish for the year had fallen to 136,638,850. This was the limit of the available supply.

This fish is found all along our Atlantic coast from Florida to Newfoundland, but it is most abundant from the Hudson River to the Potomac. Of all our fishes, it stands third in commercial value, being surpassed only by the quinnat salmon and the cod.

Including both the Atlantic and Pacific coasts, the value of the Shad catch for 12 months ending in 1899 was 49,780,530 pounds, worth \$1,519,946.

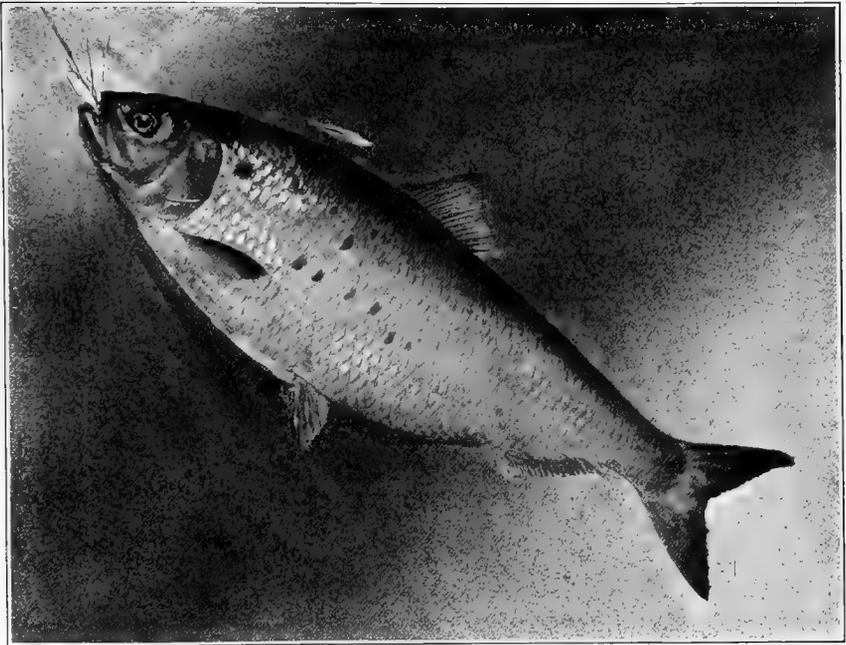
The latest Shad statistics for the whole United States are about ten years old, but they stood in 1902-1905 as follows:

The Northeastern states (1905),	1,260,904 pounds,	worth	\$87,670
Middle Atlantic states (1904),	16,954,738	“ “	995,140
South Atlantic states (1902),	9,849,338	“ “	605,539
Gulf states (1902),	150	“ “	3
Pacific coast states (1904),	489,505	“ “	13,146
	<hr/>		
	28,554,635	“ “	\$1,701,498

A falling off of 21,000,000 pounds in the annual supply of our finest food fish between 1904 and 1914 is a serious matter. Where will we go for Shad ten years from now?

In the Chesapeake Basin, says the report of the Fish Commissioner for 1913, the catch of Shad for that year was

“the poorest in many years,” with no prospect of improvement five years hence. In the Potomac River, conditions were the worst in forty years. Shad culture is deprived of its life-blood by the capture of fish in salt water, before they could



THE COMMON SHAD.

reach their spawning-grounds. “The remote cause of the present condition is excessive fishing in former years and the lack of even the minimum amount of protection that is demanded by regard for most elementary principles of fishery conservation. Fish entering the Chesapeake Bay have to run through such a maze of nets that the wonder is that any are able to reach their spawning-grounds and deposit their eggs.”

If any one imagines that the Fisheries Bureau can procure each year enough Shad eggs to maintain the supply of Shad, that idea should be abandoned, for it is wholly fallacious. The Shad fishermen have the alternative of giving the Shad a semblance of a square deal or else seeing the supply rapidly dwindle away from unfair and excessive fishing.

Originally, the Shad was not a habitant of Pacific waters; but in 1871, Mr. Seth Green, of Rochester, made for the California State Fish Commission the initial experiment of transporting 10,000 young Shad across the continent, and planting them in the Sacramento River. From that year up to 1880, about 60,000 more fry were deposited in that stream by the United States Bureau of Fisheries. In 1885 and 1886, 910,000 Shad fry were planted in the Columbia and Willamette Rivers.

To-day, on the Pacific coast, the Shad ranges from southern California to southern Alaska, and is one of the most valuable food fishes of that region. In 1899 the fish-dealers of California alone handled 1,137,801 pounds, worth \$14,303.

The average length of the Shad is from 24 to 30 inches, and its weight is from 3 to 4 pounds. The color of the fish is a soft, silvery white, all over, but the scales are easily detached, and an immaculate specimen is rarely seen in a fish-market.

To landlocked Americans of the upper Mississippi Valley and the shores of the Great Lakes the COMMON WHITEFISH¹ is an undisguised blessing. To them it is all that the shad is to the East, or the salmon to the Pacific coast. Whenever

¹ *Co-re-go'nus clu-pe-i-for'mis.*

the traveller between Cleveland and Omaha discovers before him a large fish of excellent flavor, he may be sure that it is either a Whitefish or a lake trout, from one of the Great Lakes, and worthy of profound respect.

But for the fact that this fish is so well and so widely known, many pages might be written of it without exhausting the subject. Dr. Jordan considers the Whitefishes the most important group of fresh-water fishes of North America, and probably of the world.

The home of this group extends from Niagara to Chicago and Duluth. The average weight of a typical fish is about 4 pounds, but specimens weighing 20 pounds have been taken. In 1899 the catch of Whitefish (all species) amounted to 6,862,094 pounds, worth \$345,640. In 1898 the catch in Canadian waters, say Jordan and Evermann, amounted to about 18,000,000 pounds, worth \$877,000. The latest returns from our Whitefish industry are as follows:

The Great Lakes (1903),	7,519,615	pounds,	worth	\$337,866
Interior waters (1900-1903),	209,146	“	“	12,320
	<u>7,728,761</u>	“	“	<u>\$350,186</u>

In winter, the Whitefish retires to the deepest portions of the Great Lakes, and is beyond the reach of fishermen. In the spring, it frequents the shallower waters, near shore, where it spawns, and lingers to fall a prey to the gill-net fishermen, even until late in the autumn.

CHAPTER LII

ORDER OF FLYING FISHES

SYNENTOGNATHI

THE COMMON FLYING FISH¹ is as necessary to a perfect ocean voyage as a whale and a school of “dolphins.” Suddenly and unexpectedly it breaks out of the side of a wave, and with a tremulous flutter of wing-like pectoral fins—that from the ship’s fore-castle seem to be ultramarine blue—it feebly guides its course away from the disturbing mountain of throbbing steel. The flight of a Flying Fish is usually from 4 to 6 feet above the water, and is sustained for from 50 to 100 feet. The greatly enlarged pectoral fins act as wings and furnish the motive power.

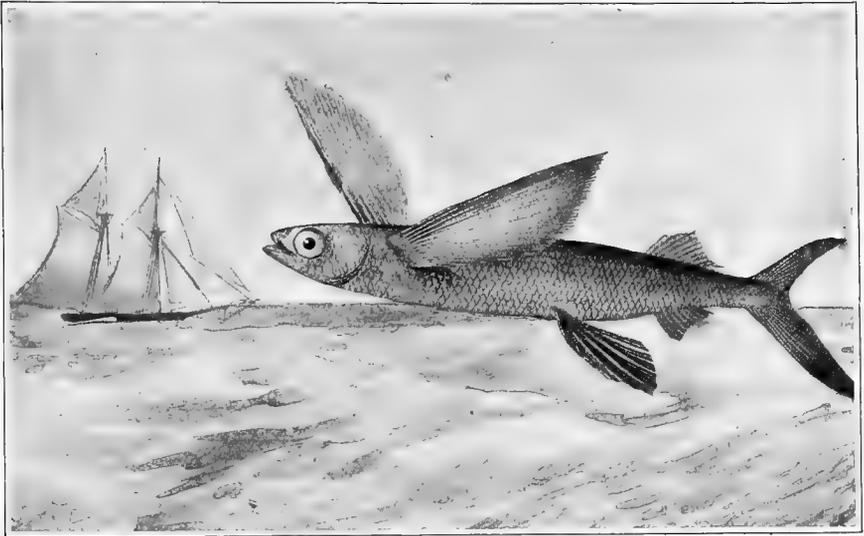
Some one has raised the question, “Does a Flying Fish move its wings in flight?” Of course it does. On all up grades it gives a stiff wing-stroke about every 3 feet, rises to overtop each advancing wave, and drops as the wave rolls on, like a stormy petrel.

This is distinctly a mid-ocean fish, but it swims in schools so near to the island of Barbados that the fishermen capture it in great quantities for the markets. It is not unusual to see 2,000 in the market at one time. I have heard much

¹ *Ex-o-cae'tus vol'i-tans.*

of the pursuit of the Flying Fish by the "dolphin" (*Coryphaena hippurus*), but have seen nothing of it.

THE FLYING GURNARD, or SEA ROBIN (*Dac-ty-lop'ter-us vol'-i-tans*), is a wonderful pink fish, 8 inches long, that is



THE COMMON FLYING FISH.

found from Cape Cod to Brazil. It is often picked up on the sea-shore near pound-nets, because fishermen throw it away as unmarketable; but as fish become more scarce, *it will be eaten*. Its pectoral fins are of enormous size, but useless for flight. This fish is *not* closely related to the flying fish, but belongs in the Order of Spiny-Finned Fishes. It is the only representative of its Family in the New World, and only one other species exists elsewhere.

CHAPTER LIII

ORDER OF SOLID-JAW FISHES

PLECTOGNATHI

THE characters on which the members of this Order have been brought together are, for the general reader, rather obscure. They are strictly anatomical, and relate to the manner in which the teeth and bones of the jaw are grown together and solidified. On the whole, it will be about as easy to become acquainted with the various groups of fishes composing the Order as to learn fully and correctly the precise anatomical characters which are common to all.

This Order contains some very odd and picturesque forms; and, fortunately for the student, good examples of them are fairly common along the Atlantic coast.

THE TRIGGER-FISH,¹ or FILEFISH, is a very good species to represent this entire group. It derives one of its names from the large, movable spine of solid bone (a fin-ray of the front dorsal fin), which stands upon the foremost point of its back, with a smaller trigger behind it, like that upon an old-fashioned hair-trigger rifle. The large spine can be set quite rigidly by a neat interlocking device supplied by the second spine.

This fish is a thin-bodied creature, and its skin has the

¹ *Ba-lis'tes ca-pris'eus*.

toughness, the rigidity and even the external appearance of stamped leather, with the roughness of fine sand-paper. It is a fine fish for the first efforts of the amateur taxidermist, for it has ingrowing scales that cannot possibly come off, and its colors are equally fast.

All the Trigger-Fishes are habitants of tropical and subtropical waters, and feed chiefly upon small shell-fishes (mollusks) which their strong jaws and teeth enable them to masticate successfully. Some of them, like the *Orange File-Fish*, are brilliantly colored. In the tropics they are considered edible, but the few that exist along our Atlantic coast are not ranked as food fishes. The species shown in the illustration is the one most widely known along our Gulf coast, and also the Atlantic coast up to the mouth of the Potomac. In the Bahamas and the Bermudas, the skins of Trigger-Fishes are extensively used by carpenters in place of sand-paper for smoothing the surface of wood previous to polishing.

THE BOX-FISH, or TRUNKFISH,¹ is one of the curiosities of the tropic seas, and of curio-shops generally. Its skin is a rigid, triangular box, shaped in cross-section like an isosceles triangle, and consists of large hexagonal plates of thin bone joined firmly together by the regular integument.

Of these fishes we have four species on our Atlantic and Gulf coasts, and one off California. According to Dr. G. Brown Goode, all the species of Box-Fishes were so thoroughly and correctly studied by the fathers of natural history two hundred years ago, that their classification of the group has

¹ *Os-trac'i-on quad-ri-cor'nis*. See illustration on page 374.

stood the test of time, and come down even into these troublous times unchanged and unimproved.

THE BELLOWS FISH,¹ or RABBIT FISH, is possessed of many local names, such as *Globe*, *Bottle*, *Blower*, and even *Eggfish*. When taken from the water, and scratched smartly on the abdomen against the grain of the small spines which cover that region, it begins to pump air into its interior, the skin expands like india-rubber, and in a moment it assumes balloon-like proportions. If the fish is then thrown into the water, it floats belly upward for a moment, then suddenly the air is expelled, the fish collapses, instantly turns right side up and disappears.

This species ranges from Cape Cod to the Gulf of Mexico, and may be looked for with confidence in the pound-nets at nearly all our seaside resorts.

THE PORCUPINE FISH,² also known as *Puffer*, *Ballfish*, *Swellfish* and *Toadfish*, is another seaside "curio," although usually it is stuffed not wisely, but too swell. A tow-filled balloon of fish-skin, with spines upon it, is not necessarily a Porcupine Fish; and the seaside taxidermist should sometimes put a curb upon his zeal for expansion.

Like the bellows fish, this species can expand itself with air to about twice its normal size. Its back is covered with strong, bony spines, which in some species are an inch in length. It is a fish of tropical waters, and in Cuba is considered a food fish. The species figured is one of four which in summer visit our Atlantic coast, while two others are found on the coast of California.

¹ *Lag-o-ceph'a-lus lae-vi-ga'tus*.

² *Chi-lo-myc'te-rus ge-o-met'ri-cus*.

CHAPTER LIV

ORDER OF SUCKERS, CARP, AND MINNOWS

PLECTOSPONDYLI

THE SUCKER FAMILY

Cat-os-tom'i-dae

THIS huge Order contains 60 genera and 311 species, divided into 4 Families. Of these Families, the Sucker Family is the most important. It contains about 70 species, all of which save two are habitants of North America. Besides the Suckers themselves the Family includes the buffalo-fish, the red-horse, and fresh-water "mullet." These fishes have the mouth placed underneath the head, and fitted with very fleshy, tubular lips, well adapted for sucking food from the bottom. They have been specially formed to live upon mud bottoms and in murky water—precisely the conditions that high-class fishes abhor.

There are times when a sucker (or a carp) seems like a good fish for the table; and that is when one is very fish-hungry, and there is no other kind of fish to be had. To my mind, the flavor of the flesh is either barely tolerable, or verging closely upon disagreeable. The very numerous and wholly unnecessary bones seem like a positive affront. Although these fishes are seldom eaten by choice, by the land-locked dwellers in the interior of our great continent, to

whom clear streams and good fishes are only long-distance memories, the sucker, carp and bull-head are eaten with real relish, and a feeling of thankfulness that they are no worse. And, after all, men who can eat musky squirrels, and call them "game," ought to be pleased with suckers and carp.

THE COMMON SUCKER,¹ BROOK OR WHITE SUCKER, is qualified to represent a large section of this Family. In the home of this fish, acquaintance with it nearly always begins in the month of June, when, if ever, come perfect days, and the annual spring "run" of Suckers, up river and creek to their spawning-beds, brings them prominently into notice.

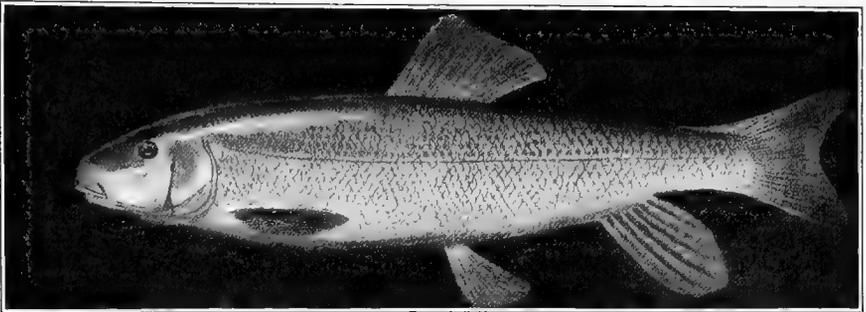
I remember one wildy hilarious day of boyhood, when a great run of Suckers came up Eagle Creek, Indiana, from the Ohio, via White River.

Now, Eagle Creek is a very beautiful stream, flowing over a fine bed of clear gravel and sand. Its waters are as clear as the sea, and the big sycamores that reach their long white arms across them are truly grand. All the young men and small boys turned out *en masse*, and rushed to a shallow, rock-bound channel above a big "drift." Each able-bodied "angler" was armed with a snare of soft brass wire loaded with enough lead to kill an elephant, and a pole that would have driven a real angler to a madhouse.

The Suckers moved about restlessly in the swift current, and occasionally paused, head up-stream. That was the snarer's only opportunity, for the fish refused all baits. The heavily loaded snare was set as a hoop five inches in diameter, gently lowered ahead of the fish, and with a very

¹ *Ca-tos'to-mus com'mer-son-i.*

steady hand and correct eye steered downward over the victim until it passed his pectoral fins. Then, at precisely the proper instant, steam was turned on, the erstwhile quiet fisherman became a raging demon of activity, and if the snare held just "so," a 16-inch Sucker weighing 3 pounds would be yanked high in air by a human derrick, amid the shouts of a delighted and strong-lunged populace. The



THE COMMON SUCKER.

string of fish caught on that halcyon day by my tall brother reached from my shoulders to the ground, and for three days the cooks of that countryside had Suckers galore.

This Sucker is perhaps the most widely distributed and the most common fish species inhabiting the United States. It ranges "from Quebec and Massachusetts westward to Montana and Colorado, and southward to Missouri and Georgia." (Jordan.) It is one of the best of its Family for the table, it is universally eaten, and is much superior to any carp the writer has ever encountered. In one year (1899-1900) the catch of Suckers in twenty-three states yielded 655,637 pounds, worth \$115,512.

THE RED-HORSE,¹ or so-called "Mullet," which makes Ohio the centre of its distribution, is an abundant and well-known fish in the region west of the Alleghanies. It is rather handsome in colors, and, although its flesh is coarse and insipid, it is really an important food fish in its region.

THE BUFFALO FISHES² comprise three species, all big and burly, ranging in maximum weight from 35 to 50 pounds, and from 2 to 3½ feet in length. They inhabit the Mississippi and its tributaries, and in the spawning season push their way even into the larger lakes and flooded marshes of Wisconsin, Iowa and Minnesota. I have seen specimens weighing between 30 and 40 pounds caught in the Mississippi, at Burlington, Iowa, by hand-line fishing between lumber rafts, with about as much interest and enthusiasm on the part of the fisherman as usually attends the capture of a good strawberry bass. One fat and fearless "angler" sat on a chair and baited his hook with cheese.

But let no one underrate the economic importance of the Buffalo Fish. The catch of 1899, chiefly in Illinois, Arkansas, Mississippi and Missouri, in the order named, amounted to 14,221,988 pounds, worth \$350,026.

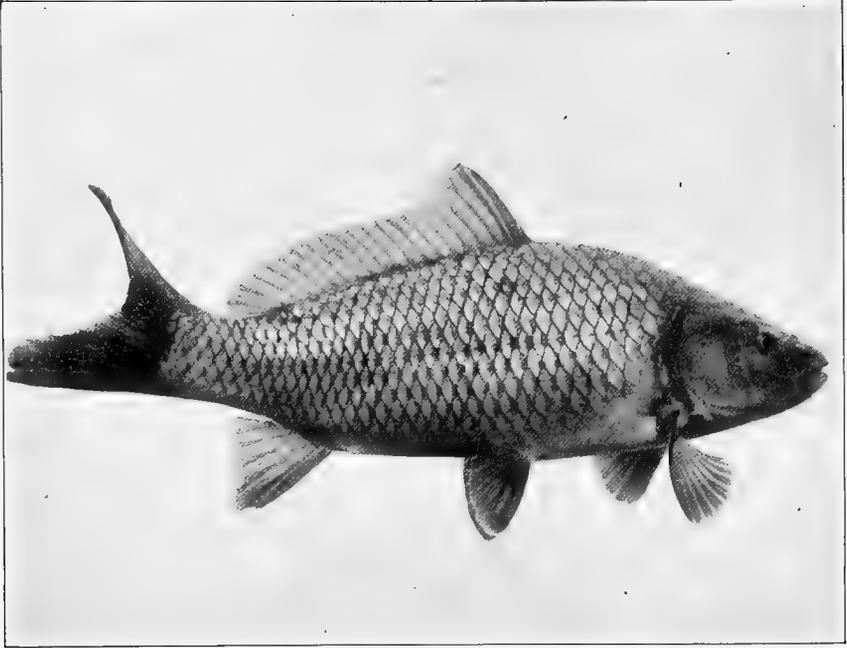
Since 1899 the Buffalo-Fish has held its own remarkably well.

The Mississippi River and tributaries yielded (1903).....	11,491,633	pounds,	worth	\$312,303
The Great Lakes (1903) yielded....	2,002	"	"	45
The interior waters (1900-03) yielded.....	33,866	"	"	1,493
	<u>11,527,501</u>			<u>\$313,841</u>

¹ *Mox-os-to'ma au-re-o'lum.*

² The common Buffalo Fish is *Ic-ti'o-bus cyp-ri-nel'la.*

THE GERMAN CARP¹ was introduced into the United States by Mr. R. Poppe in 1872, and in 1877 by the United States Bureau of Fisheries, because of the fact that in Germany it is considered a good food fish, and can live and



GERMAN SEALED CARP.

thrive in muddy ponds and streams. By thousands of prairie dwellers it was received gladly, especially throughout the Great Plains, where any fish with scales is welcomed. The free distribution of young Carp led a great many persons to apply for them, and plant them in ponds, from which they afterward found their way into streams that contained fishes infinitely their superior.

¹ *Cy-pri'nus car'pi-o.*

Between the years 1877 and 1885 the streams of very nearly the whole Pacific coast of the United States were stocked with Carp. At first they were placed in ponds, but through "moving accident, by flood and field," they reached the rivers, and impregnated them and all their tributaries. At first they were highly esteemed, and sometimes greatly overpraised. It was claimed that they were hardy, prolific, harmless to other fishes, rapid in growth, persistent under adverse conditions and acceptable on the table. Beyond question, *under certain conditions* nearly all these claims are justified by the facts!

But when the novelty wore off the Carp, the cold-blooded critic began to say things. By him it was pointed out that Carp stir up the mud in all mud-bottomed ponds inhabited by them, and keep the water murky. This is quite true; and to keep the mud-loving Carp from perpetually soiling and disfiguring the once clear and beautiful waters of the Merced Lakes, in California, first sea-lions, and then muskallunge, were introduced to exterminate the Carp.

In California the Carp is now ranked with the introduced catfish, as an unwelcome guest. It is claimed that Carp consume to a serious extent the wild celery and grasses on which wild ducks feed, and the duck supply is diminished thereby; but this charge remains to be proven. The chances are as ninety-nine to one that the choke-bore shotgun is the real and the only cause of the decrease in wild ducks.

It is also claimed that Carp eat the eggs of other fishes; which is extremely probable, for very many fishes do that.

Whatever may be said for or against the desirability of

the Carp in America, one important fact remains unassailed. That fish is now thoroughly established in our waters, and is here to stay. It is now in demand as a market fish.

The annual catch about ten years ago was as follows:

	POUNDS	WORTH
The Mississippi River and tributaries (1903)	12,270,346	\$278,565
The Great Lakes (1903).....	4,237,643	71,285
Interior waters (1900-03).....	1,016,129	12,029
	17,524,118	\$361,879

To-day the testimony of the United States Fish Commissioner is as follows (1914):

“While fly fishermen still have no words of praise for the Carp, the fish consumer has a different attitude, in view of the fact that the Carp imported from Germany has become the most widely distributed and most important fish in the interior waters of the United States. The catch at this time probably exceeds 50,000,000 pounds annually. A great deal more has been expected of the Carp than was ever claimed for it by Professor Baird, and, as you know, the fish was planted in waters to which it was entirely unadapted. For the warm, sluggish, turbid waters of the great central section of the country, where the Carp has taken firmest hold and become most abundant, this fish has few superiors.” (Hugh M. Smith.)

MINNOWS.—No common fishes of our country, it is safe to say, are so little understood, or so generally misunderstood, as those classed under the above name. To most persons, a “Minnow” is a tiny young fish, from 1 to 3 inches in length, useful only as bait for bass and other fishes.

The Minnow Family contains (says "American Food and Game Fishes") 200 genera, and more than 1,000 species, of which about 225 are found in our waters.

Many a Minnow only 2 inches in length is a fully grown fish; but some species of Minnows attain a length of from 1 to 2 feet. One of the Pacific coast species (the Squaw-Fish) sometimes reaches a length of 4 feet.

For obvious reasons, it is impracticable to attempt to set forth even the leading species of this extensive Family, but it is proper to mention that to it belong the *Hornyhead*, of the Ohio and Mississippi Valleys, the *Fallfish* of the northern Atlantic states, the *Common Chub* of the northeastern states, the *Columbia Chub* of the far northwestern states, and the *Utah Lake Chub* of Utah and northwestern Wyoming.

CHAPTER LV

ORDER OF HALF-GILLED FISHES

HEMIBRANCHII

BECAUSE of the fact that a few very small fishes have less than their rightful number of gill-arches, and shoulder-girdles with one bone only instead of two, the Order of Half-Gilled Fishes has been created.

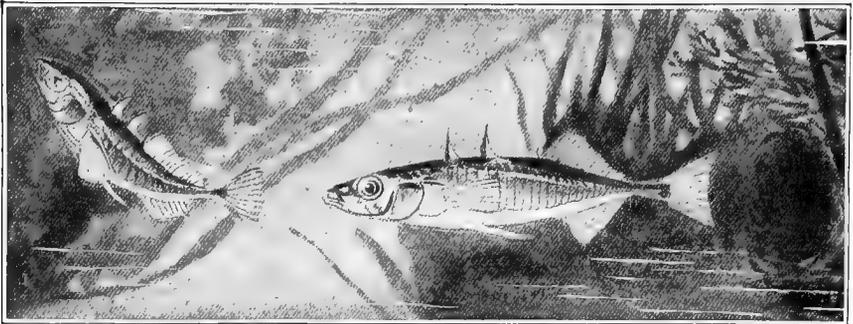
THE STICKLEBACKS are very small fishes, only a few inches in length, and derive their name from the formidable dorsal spines that stand upon the back in front of the dorsal fin. We have Two-Spined, Four-Spined, and Ten-Spined Sticklebacks, all three being found in brackish water along the Atlantic coast from Cape Ann to New Jersey.

All the Sticklebacks are celebrated for their nest-building habits. The abdomen of the male fish has been provided with a large gland which is "filled with a clear secretion which coagulates into threads" when it comes in contact with water. At first the fluid is colorless, but after contact with water it becomes whitish, and its many fibres hang together like strings of spaghetti. (Ryder.)

The entire work of nest-building is performed by the male Stickleback. It begins by selecting a bottom situation, in a gentle current, wherein the nest can be attached to two

or more stems of growing vegetation, and anchored fast. Some observers say that the fish first brings a few stems and bits of vegetation, and by means of his gelatinous secretion practically ties them fast to the upright stalks, to use as a foundation.

The fish then proceeds to exude its secretion and dispose it in commingling rings, vertically, around a space sufficiently



TWO-SPINED STICKLEBACK.

large for the female Stickleback to pass through. In a manner nothing short of marvellous, a hood-like nest is spun, of the fish's own secretion, which well retains its shape for some weeks. In this the female deposits her eggs, all the time jealously watched by the male, to prevent her from eating them! The male guards the eggs until they are hatched, and it is said that if the current flowing through the nest does not meet his views as to strength, the fish increases the volume of it by moving its pectoral fins to and fro. Sticklebacks are sometimes kept in aquaria in order that they may show their wonderful intelligence in nest-building.

THE TWO-SPINED STICKLEBACK¹ will serve as a type for the whole Order. It is only about 7 inches long, and has no commercial value. It is said to occur in quiet brackish waters along our coast, but is seldom brought into notice outside of aquaria.

¹ *Gas-ter-os'te-us a-cu-le-a'tus.*

CHAPTER LVI

ORDER OF CATFISHES

NEMATOGNATHI

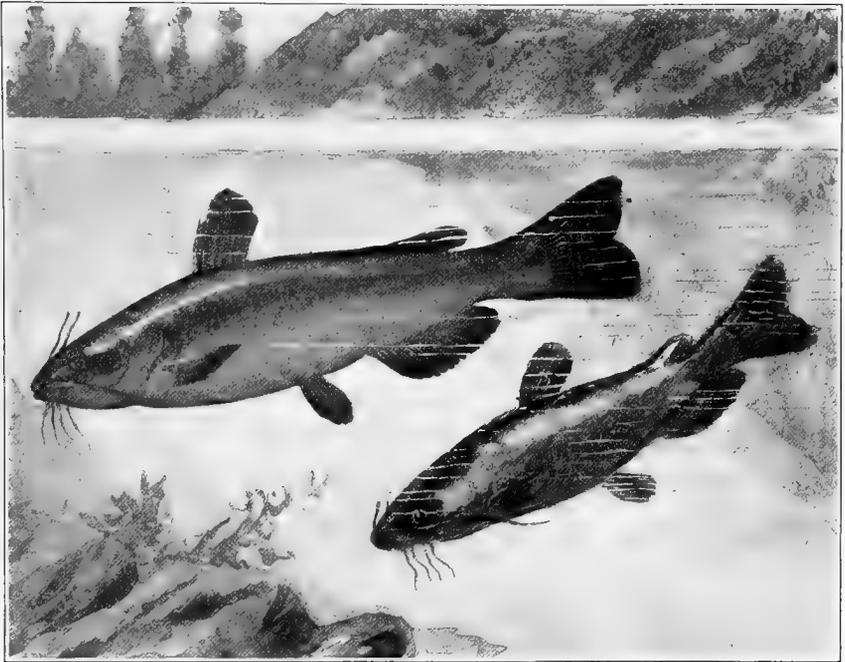
ACQUAINTANCE with this numerous Family usually begins with the bullhead, which is merely a pygmy catfish.

Even when a lad in prairie-land, thirsting for open water and aquatics, and looking upon every mile of running water as an enchanted realm, the bullhead did not appeal to me as a genuine fish. Even when most eager to "quit, and go a-fishing, and call it half a day," we drew the line at that ill-shaped, skinny body, ugly head and wide-gaping mouth with barbels that suggest dripping saliva. To me it was, and still is, a repulsive creature, and its only feature worthy of respect is the outfit of sharp and dangerous spines with which its dorsal and pectoral fins are furnished.

Excepting the big Mississippi catfish, it is the most unattractive fish inhabiting our fresh waters, and as an angler's proposition, it is worse than an eel. It is easily taken on a trot-line; and the "trot-line," set for all night across a stream, and hung with about twenty short lines and hooks, represents the lowest depths of depravity in fishing with hook and line. It is even lower than fishing with four poles.

With a tenacity of purpose worthy of a better species, the bullhead ramifies throughout the muddiest rivers and

creeks of the United States, and in the heat of midsummer holds on whence all but him have fled. He was built for mud bottoms and murky waters, and so long as the mud is thin enough to swim in, and deep enough to float him, he remains.



Drawn by J. Carter Beard.

COMMON BULLHEAD.

When removed from his native element, the tenacity of life of this creature is astonishing. A bullhead will lie on the bank in midsummer sunshine and breathe hot air for an hour without giving up.

The species of catfishes found in the United States number about thirty, but it is recorded that elsewhere there are about 970 more, representing in all about 100 genera. Of

our series, all save four are confined to the eastern half of the United States.

THE MISSISSIPPI CATFISH,¹ or BLUE CAT, of the Mississippi River and Gulf states is the giant of its genus. Even when alive and in good health, it is a very ugly fish—heavy-paunched and mud-colored. It looks like a fish modelled out of river mud. I saw a specimen taken at Burlington, Iowa, which weighed 93 pounds, and have heard of others exceeding 100 pounds. Jordan and Evermann say the “record specimen weighed 150 pounds,” and was caught at St. Louis; but the mischievous evenness of the figure casts doubt upon the reliability of the record.

Very naturally, the tons of edible flesh annually contributed by this fish to our national food supply are not wasted. Thousands of persons like the flesh of Catfish and bullheads, and in twelve months of 1899–1901, twenty-six states and six great lakes yielded twelve and a half million pounds, worth \$503,562. Illinois headed the list with 1,569,615 pounds, worth \$68,535.

THE CHANNEL CATFISH² is the large Catfish of the North, and also the Mississippi Valley, which so closely resembles the preceding species that it is at best very difficult—and sometimes impossible—to distinguish them. It is, however, much smaller than the blue cat, and instead of frequenting sluggish waters, it displays a decided preference for river channels and clear water when it can be found. Naturally enough, its flesh is said to be of better flavor than the more sluggish, mud-inhabiting blue cat.

¹ *Ic-tu-lu'rus fur-ca'tus*.

² *Ic-tu-lu'rus punc-ta'tus*.

The latest complete record of an annual catch of the Catfishes throughout the United States is as follows:

Northeastern states (1905)	104,265 pounds,	worth	\$1,459
Middle Atlantic states (1904)	1,422,886	“ “	62,676
South Atlantic states (1902)	1,310,392	“ “	30,976
Gulf states (1902)	2,415,315	“ “	72,991
Pacific coast (1904)	923,144	“ “	27,292
	6,176,002	“ “	\$195,394

THE COMMON BULLHEAD,¹ or HORNED POUT, is merely a small, cheap catfish, whose room is better than his company. It ranges from the Atlantic well into the eastern edge of the Great Plains, and from the Great Lakes to the Gulf.

Much to the displeasure of many persons in California, three species of catfish have been introduced into many streams on the Pacific coast. Concerning them, the San Francisco *Evening Bulletin* has thus recorded the facts, and its views thereon:

“Then the fish commissioners made another unfortunate experiment, against the strongest protests that could be put forth. They introduced the hated and almost worthless Catfish to the waters of California. These fish, like the carp, have multiplied rapidly. It was reported, in answer to protests made at the time, that only a superior kind of Catfish would be introduced, against which there could be no objection. But they turned out to be the same old toughs that have occupied western rivers and bayous to the exclusion of better fish. These Catfish are voracious feeders on

¹ *A-mei'u-rus nebulosus*.

young trout and salmon. Their value is so low that very few seek them. The Chinese sell them occasionally, as they do carp, if they can find a customer. But most consumers turn away from these fish in disgust.”

CHAPTER LVII

ORDER OF FLATFISHES

HETEROSOMATA

THE flounders, halibuts, soles, plaice and turbot make up the very desirable and important Order of Flatfishes. When in doubt about an English or continental breakfast, order a fried sole and you are safe; for so trustworthy is this fish that only the most bungling cook can spoil it. In England the sole is almost a national institution, but on our side its counterpart, the small flounder, is not so plentiful that it attains equal importance on the daily bill of fare.

The Order of Flatfishes, all the world over, is very large, "containing about fifty-five genera and nearly five hundred species." Among its members some of the halibuts attain great size. Almost any member of this Order is recognizable at one glance, by its broad, oval form, almost completely encircled by the fringe-like dorsal and anal fins, and the presence of both eyes on the upper side of the body. The body is so thin that "flat as a flounder" is a standard comparison wherever the English language is spoken.

The Flatfishes are good examples of protective coloring. All these fishes swim and rest with their bodies in a horizontal position. The upper surface, or back, is always darkest, and in many instances it is so skilfully colored and

mottled in imitation of the sandy bottom on which it lives, that when at rest on the floor of the ocean or aquarium the fish is almost invisible. On the other hand, the under side of the fish is white, or cream color, in order that to enemies below it, looking upward, it will match the light of the upper world.

As food fishes, the majority of the Flatfishes are very desirable. Their flesh is excellent, and their bones are few and far between. The flesh of the halibut is very white and firm, and, whether fresh or smoked, it is highly palatable.

The common flounders are so well known they require no special notice. The species most common on our coast is the WINTER FLOUNDER,¹ which is caught in great numbers, and of all our Flatfishes is next in value to the great halibut. It is a small species, with an average weight of about 3 pounds, and a maximum of 5 pounds, or thereabouts. It has been extensively propagated by the United States Bureau of Fisheries.

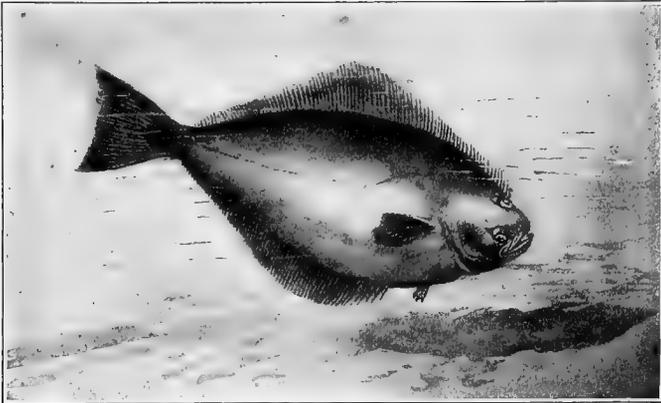
THE COMMON HALIBUT² is a cold-water fish of commanding importance. It is widely dispersed throughout both the North Atlantic, North Pacific and circumpolar waters, not only in shallow waters and the offshore banks, but also on the sides of the sea-bottom slopes down to 1,500 feet. In the Atlantic, fishermen say, the species stops at the latitude of the Delaware River. The fisheries along the west coast of Greenland are so important that regularly every year a number of schooners from Connecticut and Massachusetts go north, sometimes beyond the Arctic Circle, and

¹ *Pseu'do-pleu'ro-nec'tes americanus.*

² *Hip-po-glos'sus hip-po-glos'sus.*

return loaded with Halibut to within three feet of their deck-beams.

On the Pacific coast, according to Dr. T. H. Bean, the Common Halibut ranges from the Farallone Islands, opposite San Francisco, to Bering Strait, its centre of abundance



THE COMMON HALIBUT.

being found in the Gulf of Alaska, near Kadiak. In 1913 the catch of Alaskan Halibut amounted to 13,687,784 pounds, valued at \$671,314.

In point of size this fish is surpassed in our waters by no other good food fish, the 500-pound jewfishes being out of that class. A large Halibut is one which weighs 250 pounds or more. The largest of reliable record (at least from our waters) was observed by Captain Atwood, at Provincetown, Massachusetts. It weighed 401 pounds gross (we are thankful for that odd one pound!) and 322 pounds dressed. Dr. G. Brown Goode states that a Halibut weighing 350 pounds is from 7 to 8 feet long, by nearly 4 feet wide.

The roe of a fish weighing nearly 200 pounds, which was caught at a depth of 200 fathoms, in water only 4° above freezing-point, weighed 17 pounds, 2 ounces. A careful calculation made at the laboratory of the United States Bureau of Fisheries showed that the number of eggs in the mass was about 2,182,773.

In the year 1912 the catch of North Atlantic Halibut landed at Boston and Gloucester, Massachusetts, amounted to 3,541,539 pounds, valued at \$347,250.

CHAPTER LVIII

ORDER OF FOOT-FISHES

PEDICULATI

THE strange creatures which form the group of so-called Foot-Fishes are introduced here, not in the expectation of close acquaintance with many of them, but rather that they may not remain absolute strangers to us. They live on the bottom of the sea, are not edible and, being devoid of all value to mankind, they are safe from extermination. The most of them are also safe from close observation. Structurally, they stand next to the foot of the Subclass of Bony Fishes.

THE ANGLER, or GOOSEFISH,¹ is the typical representative of this Order. Among fishermen it is so well known that it has received twenty-one English names, and in the languages of continental Europe about fifty more. (G. Brown Goode.)

It is the glutton of the sea, and its body is merely a purse-like attachment to a mouth that is fearful and wonderful to behold. It has a mouth and an appetite like an old-fashioned carpet-bag, and to it no living thing comes amiss. At present the body of this creature is painfully small for a mouth so ambitious and all-absorbing, but evolution is doing its

¹ *Loph'i-us pis-ca-to'ri-us.*

perfect work, and eventually the maw of the Angler will be developed on the same scale as its mouth.

By taste and habit the Angler is in the same class as the human fish-hog who fishes with three poles at once. He lies on the bottom of the sea, where the muddy mottlings of his skin give him the appearance of mud and sand, opens his head widely, and props it open, for the free admission of any fish, crustacean, reptile or aquatic bird that chooses to enter.

Dr. Goode observes that the Goosefish derived that name from the swallowing of live geese, and that there is an authentic record of the capture of one which contained seven wild ducks.

A fully-grown Angler is about 4 feet long, and its mouth is a little more than a foot wide. From snout to tail its lower jaw and the median line of the body are fringed with tiny barbels most cunningly calculated to lure unsuspecting fishes within seizing distance.

The weight of a large specimen is from 35 to 40 pounds. In our longitudes it is used only for bait, but Dr. Goode says that "in Italy it is much esteemed as an article of food." No doubt of it. In Naples they eat stewed octopus; which I can testify is as tender and palatable as rubber hose stewed in brine, but not any more so.



THE ANGLER.

CHAPTER LIX
ORDER OF EELS

APODES

WHENEVER a fish-like creature looks so much like a snake that it becomes necessary to inform people "it is not a snake, but a fish," then it is time to place it and all such creatures at the foot of the class of Bony Fishes. But for the good, hard bones in its skeleton, its descent to a position below the Order of Rays would be swift and sure.

As a real fish, an eel is little more than a caricature, and he who eats it must first skin it, just as the Dyaks of Borneo do their water snakes before they roast them. It is the vulture of the waters, and prefers to feed upon things dead.

But again are we reminded that there is no accounting for differences in taste. Both in Europe and America they have been eaten ever since the days of the Cave-Dweller and Mound-Builder. And even to-day they are devoured, not with toleration, but with a degree of avidity worthy of better meat.

A German writer who catalogued the good points of the eel set forth prominently the fact that it is an excellent scavenger, and devours dead fish, crabs and any fleshy prey, living or dead, that it can secure. Those who wish to pursue the subject of the food habits of the eel to its logical conclu-

sion can find it in a notable epic by Canon Ingoldsby, entitled "The Knight and the Lady."

Nevertheless, in times past the eel has contributed a great store of edible flesh to the people of New England—where some of the finest of fishes have always been abundant! There eels are eaten—stewed, fried, pickled and salted. The flavor of an eel is not half bad, but its choice of food is decidedly objectionable. If eels are to be eaten by civilized people, then why draw the line at sharks, whose flesh is far superior to that of eels?

The United States Bureau of Fisheries has taken the eel quite seriously, and been at considerable pains to introduce it in the upper Mississippi Valley, the Great Lakes above Niagara Falls, and on the Pacific coast. And yet, Professor Baird recorded this very pertinent statement:

"It [the eel] is, however, a very undesirable inmate of rivers in which fish are taken by means of gill-nets, the destruction of shad and herring in the waters of the Susquehanna and others farther south being enormous. *It is not unfrequent that, when a gill-net is hauled up, the greater part of the catch consists simply of heads and backbones, the remainder being devoured by myriads of eels in the short time the net is left out.*"

Is such a rapacious scavenger as this a species worthy of introduction in any new waters save those of an avowed enemy?

The maximum length of the COMMON EEL¹ is about 4 feet, but the average length is less than 3 feet. The female

¹ *An-gu-il'la vul-gar'is.*

lays an enormous number of eggs—estimated at ten millions—preferably in salt water; but the young enter fresh water to develop and ascend as far as they can go.

THE ELECTRIC EEL¹ of South America is an Eel worth knowing. Having had with it some thrilling experiences, I can speak of it feelingly.

Once while canoeing for zoological specimens in the delta of the Orinoco, we entered a large creek flowing into the



THE ELECTRIC EEL.

main stream from the south, and ascended it to the head of canoe navigation. It was a clear and beautiful stream, full of zoological wonders, and its Venezuelan name was Canyo del Toro, or Bull Creek. On the way up, our bow boatman checked the speed of the canoe, pointed to a straight, round stick of wood floating in the water about a foot below the surface, and said in an awestruck tone, "*Tremblador! Grande!*"

The stick of wood was smooth, barkless and of a bluish-gray color; and in reality it was a large specimen of the renowned and dreaded Electric Eel.

Acting on the collector's principle that the first specimen

¹ *Gym-notus e-lec-tri-cus.*

seen must be the first one taken, my companion poised his capybara spear and drove it into the creature's body. The detachable head promptly came off, and the spearman held fast to the handle.

Instantly the big Eel became a storm centre of the first magnitude; and it writhed and struggled and thrashed about until it struck against the handle of the spear. Mr. Jackson received such a shock that he cried out from the pain of it, and dropped the spear-handle, which floated on the water.

But not for long. My friend recovered his spear-handle and drew the fiercely struggling Eel within striking distance of the canoe. Whenever it struck the side of the boat, either with head or tail, we were thrilled by a shock. At last, two or three severe blows on the head, with the club used for killing capybaras, seemed to settle matters and, against the protests of Antonio, the creature was dragged aboard.

To all appearances the Eel was dead; but a few moments later when Antonio chanced to touch it with his bare foot, at once he broke out in a torrent of anathemas upon all "trembladors." As an experiment, I touched its head with the tip of my finger, and instantly received a shock so severe that my nerves tingled for an hour. A more vigorous application of the capybara club finally killed the creature, and its electric power died with it.

This specimen measured 6 feet 4 inches in length, and I believe that when delivered to advantage its electric power was sufficient to administer a severe shock to the largest elephant. Woe to the crocodile or shark which attempts to dine or sup at the expense of *Gymno'tus elec'tricus!* While

on the Canyo del Toro we saw about ten specimens, always of the same floating-stick appearance, and captured four.

THE LAMPER "EEL," as the Lamprey is very frequently called, is not a true eel of any sort, and it will be found in its proper place, immediately following the fishes. It is so low in the zoological scale that for it and kindred forms a separate Class has been provided.

CHAPTER LX

ORDER OF PIPEFISHES AND SEA-HORSES

LOPHOBRANCHI

AT the foot of the Subclass of Bony Fishes stand certain small creatures, each of which is so fantastic in form that it requires to be introduced with the solemn assurance, "This is a fish!" At first glance, any one wholly unacquainted with them might from their hard external shells be inclined to regard them as particularly odd crustaceans; but the presence of tiny fins without and skeletons more or less bony within, place them fairly within the confines of the Bony Fishes.

THE GREAT PIPEFISH¹ is a long, slender stalk of jointed bone, with queer little fins very far apart, and a head that terminates in a long, hollow tube. But for this very tough and persistent bony armor, other small fishes would devour the Pipefishes, bit by bit, as children bite off sticks of candy. Its armor is so stiff, however, that the wearer moves slowly and with difficulty, and the prey usually sought by this fish is found very small and weak, hiding in the branches of seaweed, coral clusters, sponges, and the sea-grasses generally. It was for insertion into such hunting-grounds as these that the long, tubular snout of this fish has been developed.

¹ *Syng-na'thus a'cus.*



GREAT PIPEFISH.

THE SEA-HORSE.

The Pipefishes swim in a half-vertical position, as if literally leading up to the introduction of the next species, which swims bolt upright in the water, and fairly caps the climax in fishes. All the Pipefishes are small creatures. Our largest species is found on the Pacific coast, and "reaches a length of 18 inches." (Jordan and Evermann.) There exist in North American waters about thirty species.

THE SEA-HORSE¹ bears not the faintest resemblance to a typical fish, and is the strangest-looking creature of the whole fish world. It looks like a Chinese dragon reduced about a thousand diameters. Its minute pectoral fins are so inconspicuous they are at first quite unnoticed, and the fan-shaped dorsal fin seems when in action like a stationary fan with which the outlandish creature frequently tries to fan itself.

At all times the Sea-Horse swims in a perpendicular attitude, and with its prehensile tail it holds itself stationary by grasping any inanimate object that either grows upon the bottom or floats in the water. Like the pipefish, it is completely encased in a strong suit of bony plate-armor. The average aquarium Sea-Horse is seldom more than 4 inches in length, but the Gigantic species (*H. ingens*) of the Pacific coast "reaches a length of nearly a foot." (J. & E.) The smallest species, found abundantly about Pensacola, is only 2 inches long.

¹ *Hip-po-cam-pus hep-tag'o-nus.*

CHAPTER LXI

ORDER OF THE DOGFISH

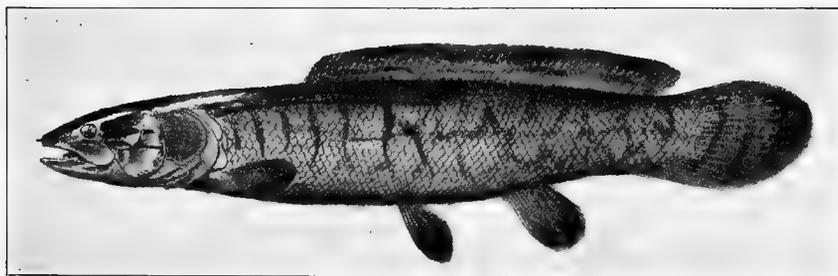
HALECOMORPHI

TO naturalists, the DOGFISH¹ is a creature of much interest. Like the prong-horned antelope, it is so unique and peculiar that it has been necessary to create for it a grand division of classification which it occupies all alone. The antelope is only a Family, but this fish is a whole Order. Its other English names are *Mudfish*, *Bowfin*, *Grindle* and *Lawyer*; and since Linnaeus christened it *Amia calva*, in 1766, eleven other naturalists have given it eleven other names in Latin.

The Dogfish has an air-bladder that is divided into cells, and is a half-developed lung. At intervals it ascends to the surface of the water, gulps down a mouthful of air, just as a turtle does, and descends again. If hindered from rising when the time comes to take in a supply of fresh air, the fish struggles violently, like a mammal about to be drowned; but it can expel air while below the surface. This character indicates that lungs were first developed in fishes from modifications of their air-bladders. Other characters establish a distinct relationship with the gar fishes, and place it in the Subclass *Ganoidea*. The dorsal fin is low, of uniform height throughout, and is about one-half as long as the entire fish.

¹ *Am-i'a cal'va*.

By its general anatomy, this fish appears to stand midway between the true lung-fishes and the gar pikes. It is of scientific interest only, for, save to the negroes of the South, its flesh is quite unpalatable and valueless as food. It is an inhabitant of sluggish fresh waters, attains a length of 2 feet, and 12 pounds weight. It is found in the Great Lakes, the Mississippi Valley generally, and in a few fresh-water streams on the southern Atlantic coast.



THE DOGFISH.

The individuality of the Dogfish is very positive and interesting. Among the small fry of other fishes its voracious appetite renders it very destructive to species of more value than itself. Mr. Charles Hallock, who knows it well, has thus set forth the salient points of its moral character:

“They take frogs, minnows and sometimes the spoon. Their habitat is deep water, where they drive everything before them. They are very voracious and savage. Their teeth are so sharp and their jaws so strong they have been known to bite a two-pound fish clean in two the very first snap. They are as tenacious of life as an eel. The young, when about six inches long, make a famous bait for pickerel

and pike. To use it, run the hook into the mouth right up through the centre of the head, through the brains, cast a hundred times, catch several fish, and at the end of three to six hours he will kick like a mule.

“Put a hundred in a rain-barrel, and you can keep them all summer without change of water. For the aquarium, the young have no equal, and on account of the spot in the tail they are quite attractive; but nothing else than snails can live in the tank. He will kill a lizard or any other living thing the instant it touches the water.”

CHAPTER LXII

ORDER OF GAR FISHES, OR GANOIDS

GINGLYMODI

TO the scientific student, the GAR PIKE of the middle eastern states and the big ALLIGATOR GAR of the Gulf states are two of the most interesting fishes of our whole finny fauna. They are the living representatives of a wonderful lot of dead-and-gone species which many thousand years ago laid the foundations of the fish world. By means of the impregnable bony armor with which Nature wisely provided them, they have been able to withstand the attacks of the enemies that otherwise would have exterminated them.

The simplest, and therefore the earliest forms of fishes are some of the *Gan'oids*—as the armored fishes are called—whose remains now exist only in the rocks of the Devonian age, far down toward the strata which were formed before life was. The first of these fishes—and they were well-nigh the first of all fishes—had their heads completely encased in solid bone, their eyes were placed in the tops of their heads, and they must have lived upon the bottom of the sea. And who shall say how many years have passed since the days when their dead bodies sank in the mud along the shores they frequented? To-day they are found high up in the rocky cliffs of Devonshire, England.

It must be remembered, however, that the armored fishes

were not the only ones which existed in those early days. The same rocks have yielded to science the remains of lung-fishes, sharks and sturgeons; but the so-called "bony fishes" of to-day were undoubtedly of later development than the foregoing.

Our two Gar fishes are therefore to be regarded as living relics of the Devonian age, or "Age of Fishes." There are others; but for an introduction to them, as well as the fossil forms, the reader is referred to Le Conte's "Geology."

THE LONG-NOSED GAR PIKE¹ is the species which is nearest at hand, and most accessible to teachers and students. It is found in the Great Lakes, and in large streams generally from New Jersey to Mexico, and northward in the Mississippi Valley to Minnesota. It is frequently called the *Billfish* and the *Gar*. It is said to be destructive to the young of other fishes, but Doctor Goode declares that fish remains are "rarely found in its stomach." Its flesh is unfit for food, and, except to educators, the fish is valueless. It is said to attain a maximum length of from 5 to 6 feet, but specimens exceeding 3 feet are very rare, and the majority are certainly under that length.

The armor of this fish is more perfect than any plate armor that man could make for it. It consists of diagonal whorls of solid and highly polished plates of bone, each divided into scale-like sections, and so hinged together that while fully protected the fish has abundant freedom of movement. The dried skin of a Gar Pike is as hard and unyielding as a cylinder of sheet iron.

¹ *Lep-i-dos'te-us os'se-us.*

In about the same waters as the preceding species, and very much like it, lives the SHORT-NOSED GAR PIKE (*Lepidos'teus platys'tomus*).

THE ALLIGATOR GAR¹ is a giant in comparison with both the above species, sometimes attaining 6 feet in length. It



THE LONG-NOSED GAR PIKE.

is essentially a fish of the South, and inhabits the large streams—and also many small ones—of several Gulf states, Mexico and Cuba. It is readily recognized by its short and broad snout, which is strongly suggestive of the head of an alligator.

As an instance of the manner in which fishes sometimes perish through natural causes, and become fossil, Mr. Frederic

¹ *Lep-i-dos'te-us spat'u-la.*

S. Webster tells the story of a death pool near the Rio Grande. While collecting birds near Brownsville, Texas, he discovered a large pool which had been filled by the overflow of the river, but afterward entirely cut off by the receding of the flood waters. A muddy pool 75 feet long by 25 feet wide was crowded full of Alligator Gars, living, dying and dead, varying in size from 2 feet to 6. Mr. Webster estimated that that tiny area of water and mud, no larger than a fair-sized ballroom, contained between 700 and 800 fishes, all doomed to speedy annihilation by the evaporation of the remaining water. When he discharged his shotgun into the mass, pandemonium ensued. The pool became a seething mass of frantic life, and the wild rushing to and fro of the large fishes actually threw smaller ones into the air.

A million years from now the few men of science who have not yet perished from cold may discover on the summit of a lofty, rock-ribbed mesa at the edge of a great desert, a marvellous deposit of fossil Alligator Gars, and wonder how so many fishes chose to die in the same spot. But only the rocks will then be able to tell the story of Mr. Webster's pool, and the world will be too cold to care for it.

CHAPTER LXIII

ORDER OF STURGEONS

GLANIOSTOMI

A STURGEON is a big, shark-like, wedge-headed fish, which looks as if Nature had once decided to cover it with a bullet-proof suit of bony armor, but, after setting three or four rows of plates on each side, had grown weary of the task and abandoned it. Had the plan been wrought out to a finish, it would now be necessary to skin every sturgeon with an axe.

The mouth of a sturgeon is situated underneath the head, and is provided with long, sucker-like lips, for taking food off the bottom. The principal food of sturgeons is small, thin-shelled mollusks, and other fishes are not eaten save on occasions so rare they are not worthy of note.

From the coast of California to the Caspian Sea, wherever they are found, sturgeons are fishes of desirability, and of commercial value in direct proportion to their size. Their smoked flesh is by many considered equal in flavor to halibut, and "caviare" is only the society name of air-tight sturgeon eggs. The 20 living species of sturgeons are distributed at intervals throughout the northern portion of the north temperate zone, across America, Europe and Asia. The American species are but 4 in number.

THE LAKE STURGEON¹ is from 5 to 6 feet in average length, weighs from 30 to 40 pounds, and inhabits the Great Lakes and adjacent connecting waters of good depth.

THE SHORT-NOSED STURGEON² is a salt-water species, found along our Atlantic and Gulf coasts, from Cape Cod to Texas. This is a small species, only about 2 feet in length, and is of no importance.

THE COMMON STURGEON³ of our Atlantic coast is the largest and most valuable member of this Order in American waters. It attains a length of 10 feet, and 500 pounds in weight, and to-day at Wilmington, Delaware, its centre of abundance, a large specimen represents about \$75 worth of commercial value. The most valuable part is the roe, a cask of which, weighing 130 pounds, is worth \$110.

THE WHITE STURGEON⁴ inhabits the waters of the Pacific from southern California to Alaska, and the records show it to be a giant among food fishes. Jordan and Evermann quote it up to 13 feet in length, and weighing 1,000 pounds; but the weight of any animal, dead or alive, which ends with two ciphers is certain to be a weight of Estimate, and not of Fairbanks. Strangely enough, numerous specimens of this Sturgeon have been taken in Idaho, in the Snake River, weighing from 100 to 650 pounds. "An example 11 feet 2 inches long measured 2 feet across the head." (Jordan and Evermann.)

Ten years ago (1904) the latest reports on the Sturgeon industry generally were for 12 months during 1897 and

¹ *Ac-i-pen'ser ru-bi-cun'dus.*

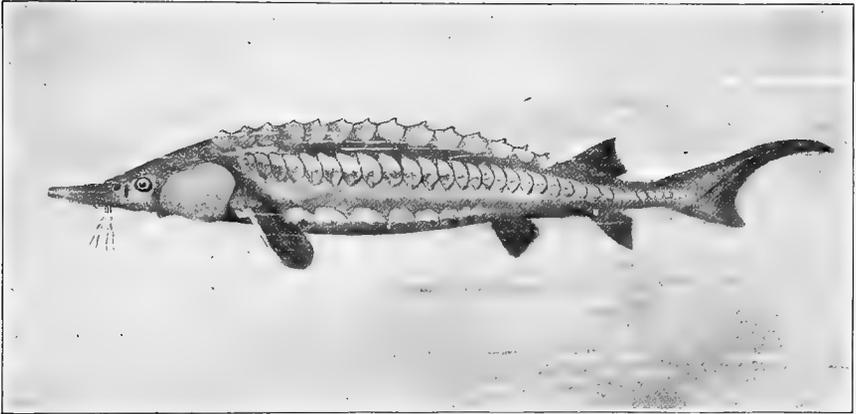
³ *A. stu'ri-o.*

² *A. bre-vi-ros'tris.*

⁴ *A. trans-mon-tan'us.*

1898. During that period, 17 states participated in a catch which amounted to 5,726,830 pounds, which sold for \$321,036. The catch in Oregon was nearly two million pounds, that of New Jersey 868,326, and Virginia next.

THE IMPENDING EXTINCTION OF THE STURGEON INDUSTRY.
—When the first edition of this Natural History was pub-



LAKE STURGEON.

lished, in 1904, the Sturgeon fishing industry of the United States was at the zenith of prosperity. Since that time a great change has taken place, and the Sturgeon is now well down the toboggan-slide to oblivion. For the sake of the lesson that the fate of this industry could teach to our commercial fishermen, if they would pause to consider it, I deem it well worth while to reproduce a page from the annual report of United States Fish Commissioner Hugh M. Smith, for the year ended June 30, 1913, page 66. It is entitled "The Passing of the Sturgeon."

PASSING OF THE STURGEON

“The story of the Sturgeons is one of the most distressing in the whole history of the American fisheries. These large, inoffensive fishes of our seaboard, coast rivers and interior waters were for years considered to be not only valueless but nuisances, and whenever they became entangled in the fishermen’s nets they were knocked in the head or otherwise mortally wounded and thrown back into the water. Even in the present generation we have seen the shores of the Potomac River in the vicinity of Mount Vernon lined with the decomposing carcasses of these magnificent fishes, witnesses to the cruelty, stupidity and profligacy of man, and the same thing has been observed everywhere in our country.

“The next chapter in the story was the awakening of the fishermen to the fact that the eggs of the Sturgeons had value as caviare and that the flesh had value as food. Then followed the most reckless, senseless fishing imaginable, with the result that in a comparatively few years the best and most productive waters were depleted, and what should have been made a permanent fishery of great profit was destroyed. Even after the great value of the Sturgeon began to be appreciated by every one, the immature and unmarketable fish incidentally caught in seines, gill-nets and pound-nets received no protection whatever in most waters and were ruthlessly destroyed as nuisances, the decline being thus doubly accelerated.

“On the Atlantic coast the catch of the Sturgeon fell from 7,000,000 pounds to less than 1,000,000 in fifteen years;

on the Pacific coast the same meteoric history was enacted, a catch of over 3,000,000 pounds annually in the early nineties being followed by a few hundred thousand pounds in later years of the same decade, with no improvement since that time, while on the Great Lakes the yield declined more than 90 per cent in 18 years. In the American waters of the Lake of the Woods, one of the most recent grounds for the exploitation of the Sturgeon, the catch decreased over 96 per cent in ten years, notwithstanding a more active prosecution of the fishing.

“The Sturgeon fishery as a whole reached its climax about 1890. For two or three years the annual catch was 12,000,000 to 15,000,000 pounds. At the present time the total yield does not exceed 1,000,000 pounds, and everywhere there is a steady downward trend in the catch. Some rivers that formerly supported a flourishing fishery are now absolutely depleted. The scarcity of the Sturgeon and the demand for their flesh and eggs have run up the price to an extraordinary figure, never attained by any other fish, either in America or elsewhere. A mature female Sturgeon often brings the fisherman more than \$150 and it is a poor fish that cannot be sold for \$20 to \$30 on the rivers of the east coast.

“The most serious aspect of the Sturgeon fishery is that, owing to the decimation of the schools of breeding fish and to peculiarities in spawning habits, it has been impossible as yet to inaugurate Sturgeon culture anywhere in America. Attempts at artificial propagation have proved utter failures on the Great Lakes, Lake of the Woods, Lake Champlain,

Delaware River, and other waters, and the expenditure of considerable sums of money by the Bureau has sometimes failed to yield a single batch of eggs suitable for incubation.

“Everywhere in America, under existing conditions, the Sturgeons are doomed to commercial extinction, and it requires no prophet to foretell that in a comparatively few years the Sturgeon will be practically extinct.

“What is demanded in every State in which these fishes exist or have existed is absolute prohibition of capture or sale for a long term of years, certainly not less than ten. To advocate any less radical treatment would be only trifling with the situation.”

.

The annihilation of the Sturgeon industry in the United States through the stupid folly of our own fishermen is but a fair sample of what Americans habitually do when they are not restrained by the hand of the law. An American individual can, and often does, act sensibly and conservatively even in the absence of law; but in every community there seems to be a large percentage of reckless individuals who ignore the dictates of reason and common sense, and ruthlessly destroy the products of nature, even to their own hurt!

In Europe the Sturgeons of the Danube, the Caspian Sea and other waters are successfully conserved, and we will be paying the Russians and Roumanians for caviare long after our once-abundant Sturgeon supply has been exterminated and forgotten.

CHAPTER LXIV

ORDER OF THE PADDLE-FISH

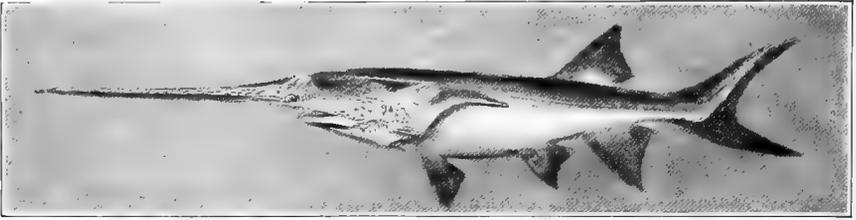
SELACHIOSTOMI

TO some persons, the big PADDLE-FISH,¹ or SHOVEL-NOSED "STURGEON," as it is more commonly called, is one of the wonders of fresh water. Here we find a case of what naturalists call "specialization," which has gone to an astonishing extreme. This is a scaleless fish, with a body very much like a shark, and a half-cartilaginous, shark-like skeleton. It has a low-browed, armor-plated head that runs forward into a broad, thin paddle of bone, one-third the length of the entire fish.

Beyond doubt, this remarkable implement is used in turning up the mud and gravel of the bottoms of the streams in which the owner lives, in searching for food. It is unfortunate that we never can see it in action, and still more so that this fish has not yet been kept successfully in aquaria. Mr. Charles H. Townsend says that in captivity they always injure their paddles against the sides of their tanks, and do not live longer than two or three weeks.

In "American Food and Game Fishes," Drs. Jordan and Evermann give a number of size records of this fish which will be a surprise to many persons who, like the writer, have

¹ *Po-ly'o-don spath'u-la.*



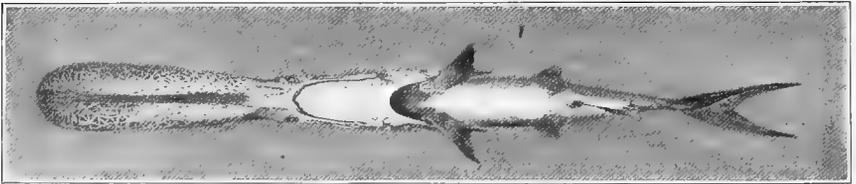
THE PADDLE-FISH.

seen and handled only medium-sized specimens. The figures given show length in inches and weight in pounds.

	INCHES	POUNDS
Lake Manitou, Ind., heaviest on record.....		163
This fish and the one next noted were 4 feet in girth.		
Lake Tippecanoe, Ind. (W. C. Harris).....	74	150
Chautauqua Lake, N. Y.....	74	25½
St. Louis (Dr. Engelman).....	70	79
White River, S. Dakota (J. and E.).....	53	18

The last record is interesting as showing the light weight of what was a long but very slender specimen. Judging from all available evidence and personal observations, I should place the average length of the Paddle-Fish at 45 inches, and weight 25 to 30 pounds.

The United States Bureau of Fisheries' records show that this fish is now coming into use as food, and is finding a ready sale in the markets of the region it inhabits. In some



UNDER VIEW OF THE PADDLE-FISH.

places its flesh is smoked and sold as sturgeon. Its eggs, which are very numerous, and greenish black in color, make excellent caviare, and are being so utilized at Louisville, Kentucky, and along the Mississippi, in Mississippi and Tennessee.

In 1899, sixteen states participated in the catching of Paddle-Fish, Mississippi leading with 981,080 pounds, and followed by Arkansas, Tennessee, Illinois and Missouri, in the order named. The total catch was 2,543,950 pounds, valued at \$82,343. The records of four years later (1903, the latest obtainable) show a great decline. The catch in 1903 was only 1,421,086 pounds, valued at \$45,906. The caviare product for that year amounted to 11,171 pounds, worth \$7,659.

In a limited sense the Paddle-Fish inhabits the Mississippi Valley, from Louisiana to Minnesota, the Ohio and the Missouri to South Dakota, which is a wide range for a fish so peculiarly formed.

CHAPTER LXV

ORDER OF THE CHIMERAS

CHIMAEROIDEI

THE Chimeras are introduced for the purpose of making our series of fish Orders reasonably complete, and not because of anticipated personal acquaintance with them. For fifteen or twenty years one may live on the Atlantic coast, frequent its fish-markets, and fish occasionally at first hand, without once seeing either a live Chimera or one freshly caught. They inhabit blue water only, have no commercial value save as scientific specimens, and in our Atlantic waters are rarely caught elsewhere than on the offshore fishing-banks of New England.

As a natural result of these conditions, the shark-like chimaeroids are the least known of all the fishes that inhabit our shore waters. Indeed, there are several species of deep-sea fishes that are much more common in fish collections than they appear to be elsewhere. One species, however, of the Pacific coast, has been studied by Dr. Bashford Dean, and it will be set forth on the strength of his description.¹

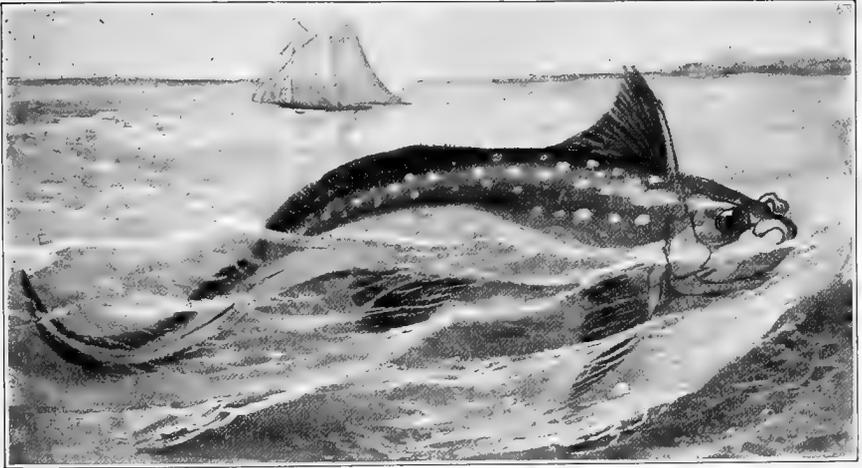
THE SPOTTED CHIMERA,² figured herewith, is said to be extremely abundant just off the borders of the submerged plateau that extends all along the northwest coast of the

¹ "Fishes, Living and Fossil," Columbia University Biological Series, page 100.

² *Chi-me'ra col'le-i.*

United States. It was frequently taken in the dredge hauls made by the steamship *Albatross*, the majority of the specimens being under 2 feet in length.

Like all the members of this Order—the total number of which is very small—this species resembles a big-eyed shark with a cutlass-fish tail.



SPOTTED CHIMERA.

The head is blunt and very thick, and from it the body gradually tapers down to the whip-like tail. The skin is smooth, and the paired fins are shark-like.

The front dorsal fin is provided with anterior spine-folds, like a fan, and may be depressed into a sheath in the body wall.

The sense organs are similar to those of sharks, and the visceral parts also are shark-like. The skeleton is cartilaginous, and the vertebral axis is notochordal. Of the embryology and life history of the Chimeras generally, practically nothing is known.

CHAPTER LXVI
ORDER OF SHARKS
SQUALI

WE have now reached the Subclass of Cartilaginous Fishes.

And what is a “car-ti-lag’i-nous fish?”

Cartilage is a bloodless tissue, commonly called *gristle*, flexible but not elastic, quite colorless, of the consistency of cheese-rind, and of use in the anatomy of animals for sustaining or connecting softer parts. The external ear of man consists chiefly of a convoluted wing of cartilage covered with skin. The so-called “breast-bone” of man is a tree-like development of cartilage designed to bridge together the outer ends of the principal ribs, protect with some firmness the vital organs within and yet permit the rise and fall of the chest in breathing.

The Cartilaginous Fishes, embracing the sharks, rays, skates and intermediate forms, are those whose skeletons are largely composed of plates and stems of cartilage, or gristle, and but little bone. Instead of bony rays, the fins of these creatures are supported by cartilaginous rays so closely joined together that they form plate-like structures.

GENERAL CHARACTERS OF SHARKS.—With few exceptions, sharks have externally the same general form as the typical fishes. Instead of broad, flat scales that overlap each other like shingles, their scales are very minute, horny, sharp-pointed



1. MACKEREL SHARK, WITH REMORA ATTACHED.
2. HAMMER-HEAD SHARK.

and closely packed together. When the skin of a shark is stroked from head to tail, it feels like a hair-cloth sofa, but when stroked the other way, it is like the sharpest sand-paper. For centuries shark-skin has been used for smoothing and polishing wood and other substances; and when prepared for that use it is called "shagreen."

Instead of one very large gill-opening, as in typical fishes, a shark has usually five small slits in the skin behind the gills, which are capable of being tightly closed. In nearly all species the mouth is situated underneath the head, and often it is of enormous proportions. The jaws are composed of cartilage, the teeth are usually triangular and set along the edge of the jaw, in rows, crosswise with the edge of the mouth. Behind each active and visible tooth there is a line of reserves, from three to five in number, always growing outward and crowding to the front, so that as soon as a tooth in the line of battle becomes much worn, or in any way weakened or broken, it is crowded off the jaw, and a new tooth is thrust forward into its place.

Many sharks bring forth their young alive; but others (the majority, perhaps) lay eggs. Some of the egg cases are of remarkable form. Some of them are rectangular, flattened and provided at each corner with a long, threadlike tendril with which to attach to any fixed object.

Sharks very rarely exhibit color patterns, or bright colors of any kind. As befits pirates and freebooters, they are mostly ashy gray, or drab—the most inconspicuous colors at sea, both for sharks and men-of-war. The small Tiger Shark, of Ceylon (*Stegastoma tigrinum*), is one of the few sharks of

variegated colors, and its handsome pattern of yellow and black is a welcome variation.

Only a few of the whole 150 species of sharks can rightly be classed as "man-eaters." A typical "man-eating shark" is one which is very large, exceedingly voracious, practically devoid of fear of mankind, and so aggressive that it will attack a swimmer at the surface of the water, and devour him regardless of his resistance. The standard prey for sharks consists of small fishes, squid, jelly-fishes, crabs, lobsters and other non-combatants.

Occasionally, however, the big Tiger Shark¹ of the Atlantic chooses a victim in his own class as a fighter. Dr. Goode notes the capture, by Captain Atwood, at Provincetown, Massachusetts, of a specimen which contained "nearly a whole full-grown sword-fish"; and "ten or twelve wounds in the skin of the shark gave evidence of the contest that must have occurred."

The "man-eater shark" is not a myth, for that name is applied to the great white shark, a species which ranges from our Atlantic coast to Australia, and on to California. In the tropics it attains a length of 30 feet. With us this creature is rated as "exceedingly rare," and, judging from Dr. Goode's notes, not more than a dozen specimens are caught and identified in a century. The only loss of life from it on our coast, so far as recorded, occurred in 1830.

It is indeed fortunate, and merciful to mankind, that sharks generally are harmless to man. Were they otherwise, the terrors of the sea would be greatly increased.

¹ *Gal-e-oc'er-do ti-gri'nus.*

THE MACKEREL SHARK¹ is a fair type of the sharks of the world. It is common along both coasts of the United States, and the length of fully grown specimens is between 9 and 10 feet.

THE HAMMER-HEAD SHARK² is a genuine curiosity. With no intermediate forms leading up to this strange departure, the head of this creature suddenly thrusts out on each side a great shelf of cartilage and skin, in the outermost edge of which the eye is situated! It is like a flat-headed shark with a 7-inch board 20 inches long placed squarely across its forehead. This species is found in the seas of the tropics and subtropics, practically around the world. Once when the writer was approaching the coast of Barbados, on a sailing vessel, a large Hammer-Head swam for fifteen minutes close to the bow of the ship, and quite near the surface. In the Havana market I once obtained a specimen nearly 10 feet long. This species brings forth its young alive, and occasionally specimens are taken as far north as New Jersey.

SIZES OF SHARKS.—The majority of the species of sharks are under 8 feet in length, and a few are as small as 2 feet, when adult. The largest species are the following:

The BASKING SHARK (<i>Rhinodon typicus</i>).....	45 feet.
The BONE SHARK (<i>Cetorhinus maximus</i>).....	36 “
The MAN-EATER, OF WHITE SHARK (<i>Carcharodon carcharias</i>)....	30 “
The GREAT TIGER SHARK (<i>Galeocerdo tigrinus</i>).....	30 “
The HAMMER-HEAD (<i>Sphyrna zygaena</i>).....	15 “
The BLUE SHARK (<i>Carcharias caeruleus</i>).....	15 “
The THRESHER SHARK (<i>Alopias vulpes</i>).....	15 “
The MACKEREL SHARK (<i>Lamna cornubica</i>).....	10 “

¹ *Lam'na cor-nu'bi-ca.*

² *Sphyr'na zy-gae'na.*

CHAPTER LXVII

ORDER OF RAYS AND SKATES

RAIAE

THE rays and skates are merely flat-bottomed, side-wheel sharks, built to navigate very shallow waters. From the typical shark down to the broadest and flattest ray, the change of form is shown by a beautifully complete series of living links, several of which it has been my privilege to handle and dissect fresh from their home waters.

Of these connecting links, the most interesting is the rare and wonderful SHARK-RAY,¹ of the Indian Ocean, a fine specimen of which was caught for me in the shallow waters between Ceylon and India. It is as nearly as possible half shark and half Ray, and is shown in the accompanying illustration.

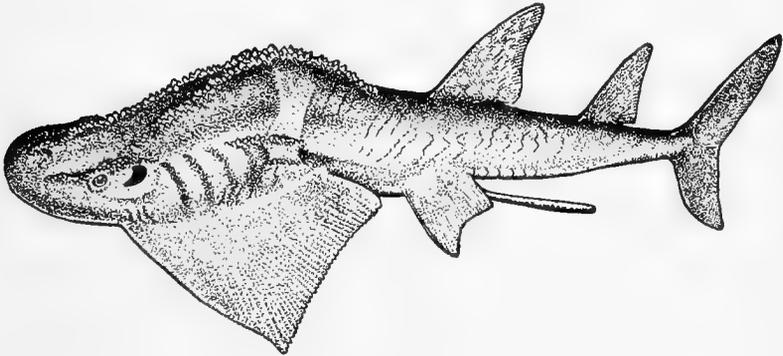
Between this and the typical ray stands the BEAKED RAY,² much flatter than the preceding, and with the pectoral fins taking on ray-like spread and thinness. But the long, fleshy body and triangular head still proclaim very unmistakably the line of relationship with the sharks. Several species representing this intermediate type are found in our

¹ *Rham-pho-ba'tis an-cy-los'to-mus*.

² Of the genus *Rhi-no-ba'tis*. The species sometimes seen on the coast of Florida is *R. len-tig-i-no'sus*.

waters, but they are not common, and the real home of the genus is in the tropics and subtropics.

THE SAWFISH,¹ of the Florida coast, and many portions of the tropics farther south, is celebrated among fishes because of the very long, flat beak of bone which projects forward from its snout, armed on both sides with formidable teeth. The length of this saw is more than one-third the length of



SHARK-RAY.

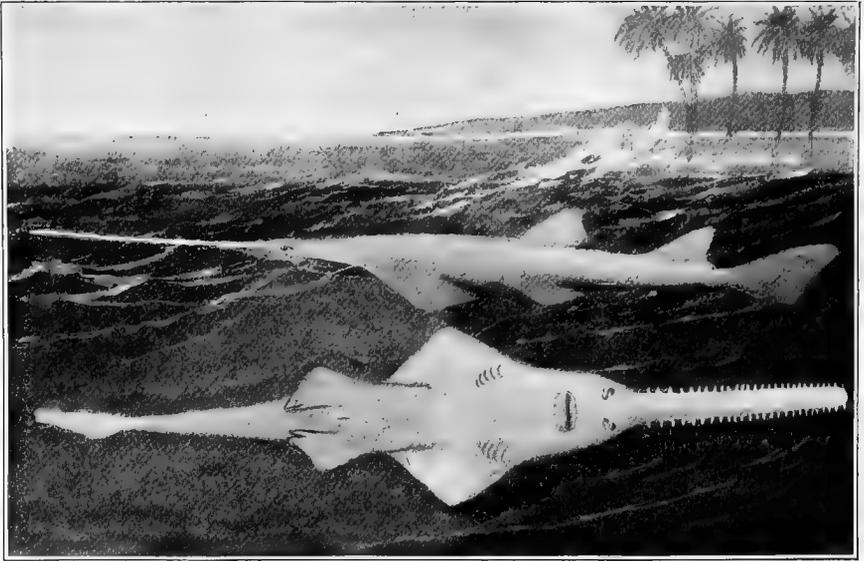
the head, body and tail. It is, we may safely assert, strictly a weapon of defence, not offence; for unless it is used as a shovel in searching for mollusks and other food on the bottom of the sea, it is useless in the search for food.

When the Sawfish is threatened with attack, however, it defends itself by quickly curving sidewise, thereby giving a sweeping sidewise stroke with its saw, and swiftly repeating it in the opposite direction. On a Sawfish 14 feet in length, the saw is about $4\frac{1}{2}$ feet long, and the teeth project about $1\frac{1}{2}$ inches from the bone.

This creature is an intermediate form between the sharks

¹ *Pris'tis pec-ti-na'tus*.

and the typical rays, and in reality it is a shark-ray. Its eyes are atop of its head, its mouth is underneath, its body in front of the dorsal fin is quite well flattened, and its pectoral fins have "ray" written all over them. The maximum



THE SAWFISH.

length attained by it is said to be 15 feet. Because of the long, flat beak of this creature, it has become associated in many minds with the swordfish, but structurally the two are as far apart as a deer and a bear.

Notwithstanding the fact that there exists a group called the Order of Flatfishes (halibuts, flounders and soles), the rays are by far the flattest of all fishes. For example, the Spotted Ray of Ceylon is about 5 feet across, 5 inches thick at the centre of the body and at the edges its great wings

flatten out into thin air. From the body, which really is quite small, and centrally located, a thin sheet of cartilage, consisting of a great number of very long, jointed rays firmly joined together, extends outward to the very tips of the wing-like fins. Upon this is laid a thin layer of flesh, and over



THE STING RAY.

all is spread the rough and tough skin. The tail is like a long, stiff whip, with a many-barbed bone stiletto midway—a very dangerous weapon to be so carelessly exposed.

To a taxidermist, the mounting of a large ray is about the most calamitous task he can possibly encounter. The trouble lies in the perpetual shrinking after mounting.

THE STING RAY,¹ or, by corruption, “STINGAREE,” is one of the greatest pests of the eastern coast of the American

¹ *Try'gon sa-bi'na.*

continent. From Cape Cod to the Orinoco, and I know not how much farther beyond, this vindictive and cruel fish lies, assassin-like, half buried in the sand alongshore, ready and anxious to drive its spine into any naked foot that comes within striking distance. The upper surface of the animal closely resembles the loose sand in which it hides, and the spine makes a ragged and ugly wound. The spine is long, dagger-like, and barbed like an arrow all along both edges, so that the withdrawal of it from a wound is very painful. On the lower Orinoco I saw a strong man who was then in the seventh week of disability from the stroke of a Sting Ray in his foot; and in the Malay Peninsula I treated a Malay fisherman whose hand had been completely transfixed by the spine of a huge ray.

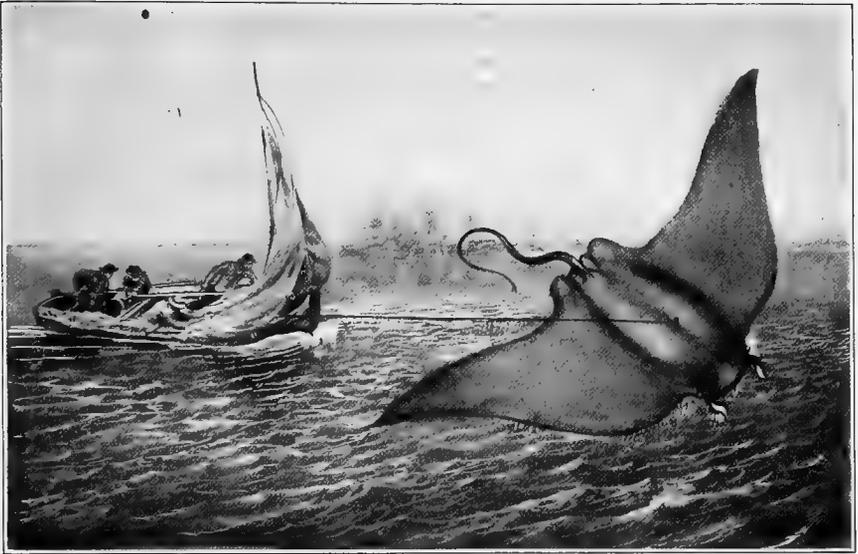
Fortunately, this abominable creature is averse to cold or even moderately cool waters, and is rarely encountered even as far north as Florida. On our coast one may bathe for a lifetime without seeing even one; and in all waters they carefully avoid crowds of bathers.

The gigantic creature known as the DEVIL-FISH¹ is the largest of all rays, and to many persons even the most truthful accounts of some of its doings will seem beyond belief. To begin with, its maximum size of 20 *feet* across its "wings" is almost incredible. The towing of a good-sized fishing-smack by a harpooned Devil-Fish, going for miles at race-horse speed, is another wonder of the deep.

Many years ago the planters on the coast of South Carolina found royal sport in harpooning this monster, and con-

¹ *Man'ta bi-ros'tris*.

quering it. In a volume entitled "Carolina Sports," the Hon. William Elliott has drawn this picture: "Imagine a monster many feet across the back, having powerful flaps or wings with which he drives himself furiously through the



THE DEVIL-FISH.

water, or vaults high in the air, his horns projecting several feet beyond his mouth!"

A Devil-Fish leaping out of water—as we know a Devil-Fish can do—would look as Mr. J. Carter Beard has represented it in his illustration.

Dr. C. S. Olds, of Marco, Florida, once was almost overwhelmed by a Devil-Fish 7 feet in width that leaped out of the water ahead of his motor-boat and crashed full upon the awning of his craft, with smashing force.

So far as can be learned, large examples of this creature are now rarely observed, and still more rarely captured. Its centre of abundance now appears to be off the Gulf coast of Florida; but it is also found on the coast of southern California.

CHAPTER LXVIII

LOWEST CLASSES OF VERTEBRATES

THERE are a few creatures which, by reason of their internal skeletons and jointed back-bones, are justly entitled to stand with the vertebrates, but yet are lower in the scale than the lowest fishes. For these it has been necessary to create two grand divisions of the first rank; and they stand as two small and very low Classes. It is because of their very low position in the zoological scale of vertebrates that it becomes important to know them.

THE LAMPREYS *Class Marsipobranchii*

A LAMPREY is an aquatic creature which bears so strong a resemblance to an eel that for a long period all Lampreys were regarded as true eels. Even to-day the most important of our species is, by unscientific persons, almost universally called the "LAMPER EEL." In view of the general external resemblance of these creatures to eels of similar size, it is not strange that their true character remained for a long period quite unknown. As a matter of fact, these creatures forcibly illustrate the unwisdom in animal classification of attaching too much importance to external characters.

The lampreys are the lowest and last creatures that have the spinal cord expanded at its upper end into a brain and encased

in a skull. But the skull is imperfectly developed and without jaws; there is no shoulder girdle, no pelvis, no limbs, no ribs and no paired fins. There is a single median nostril, the gills are purse-shaped, the skin is naked like that of an eel and the skeleton is cartilaginous. The gills are in the form of a fixed sac, the gill openings consist of a row of tiny round holes along the side of the body, and the mouth is specially formed for suction.

It is evident from the foregoing characters that the lampreys are creatures of very simple form, lacking almost all the evidences of special development which characterize the higher fishes. Externally, their very modest median fins are the only visible signs that they are not marine worms.

THE SEA LAMPREY¹ is the best and most available example of the Class *Mar-si-po-branch'ii*. "The mouth is completely circular, and forms a great and powerful sucker, surrounded by fleshy lips that are supported on a framework of cartilage and studded with tentacles. This mouth is covered over its entire interior surface with strong teeth arranged in concentric circles. A large double tooth, situated above the aperture of the mouth, indicates the situation of the upper jaw, and seven or eight great teeth represent the lower jaw. Even the tongue carries three large teeth, deeply serrated on their edge."²

With a mouth specially formed and savagely equipped for suction, it is no surprise to find that this creature is a blood-sucking parasite, preying upon other forms of marine

¹ *Pet-ro-my'zon ma-ri'nus*.

² "Fishery Industries of the United States," Part I, p. 677.

life. It is often found attached to shad, sturgeon, sharks, cod, halibut and mackerel. It fastens to its victim beneath the pectoral fins, tears at its flesh with its rasping circles of teeth and sucks its blood "until the flesh becomes as white as paper." Beyond doubt, these creatures destroy a very considerable number of valuable food fishes. Fishermen charge to the account of the Lamprey the raw spots and sores frequently found upon the bodies of sturgeons.

Formerly the Lamprey was greatly esteemed by the people of Massachusetts as a food "fish." In the Merrimac River it was captured in great numbers, and salted down for winter use. While this industry, and its object, have both greatly decreased, in some portions of Connecticut the Lamprey is yet taken, as often as it can be found, and thankfully consumed. The species specially mentioned varies in length from 2 to 3 feet, but the *Brook Lamprey*, and all the fresh-water species are much smaller. Fortunately, none of the fresh-water species are so injurious to fishes as the *Sea Lamprey*.

According to Jordan and Evermann's "Fishes of North and Middle America," there are in American waters ten species of lampreys, and two of their very near, but still lower, relatives, the *Hag-Fishes*. They are scattered at intervals from Alaska to New England, in brooks, rivers, lakes, estuaries and various other bodies of shallow water. They are most accessible in fresh water, on a stony or gravelly bottom; and whenever in such a situation you find an eel-like creature holding fast to a stone by the suction of a big flat mouth on the end of its head, know of a surety that it is a Lamprey.

*THE LANCELETS**Class Leptocardii*

The long and interesting chain of Vertebrates ends in a very weak and insignificant link. The great work entitled "Fishery Industries of the United States" dismisses this creature with only two and a half lines, and leaves three-fourths of the page blank.

And truly, the LANCELET, or AMPHIOXUS,¹ is not a creature calculated to arouse enthusiasm. Its skeleton is composed of membranes and cartilages. It has no brain, nor even a skull in which to develop one. It is neither eel-like nor worm-like, but as its name implies, it is shaped like the head of a lance. The middle line of the body is provided with weak and indifferent fins. There is no proboscis, and the mouth is slit-like, and fringed with hair-like filaments. All the above characters, and many others of a purely technical nature, are set forth in "The Fishes of North and Middle America," where eight species are recognized.

These small, naked, colorless and translucent creatures are found "embedded in the sand in the shallow waters of warm coasts throughout the world." They are of special interest only because they are the lowest of the Vertebrates, and on the whole they constitute a very ignominious ending for the highest grand division of Nature.

And thus ends our bird's-eye view of the Vertebrates, setting forth the prominent types and examples which every

¹ The West Indian Lancelet (*Brach-i-os'to-ma car-i-bae'um*) is found from Beaufort, North Carolina, to the mouth of the La Plata.

intelligent American should know. *It is here, and here only, that "specialization" may properly begin!* Behind lie the Mammals, Birds, Reptiles and Fishes; beyond lie the mighty hosts of the Invertebrates—Crustaceans, Insects, Mollusks and others. In any one of these grand divisions of life the special student may wander for a lifetime in a wonderland of his own, and to the last find each day filled with new light and new joys in the unending revelations of Nature.

INDEX

INDEX

- Aard-Varks, II, 180, 184.
- Accipiter atricapillus, III, 70.
 " cooperi, III, 68.
 " velox, III, 67.
- Acipenser brevirostris, IV, 298.
 " rubicundus, IV, 298.
 " sturio, IV, 298.
 " transmontanus, IV, 298.
- Actodromas minutilla, III, 134.
- "Adder," Blowing or Spreading, IV, 93.
- Agelaius phoeniceus, II, 313.
- Agouti, I, 258.
 " Family, I, 181.
- Agriculture, Department of (*see* Biological Survey), III, 23.
- Aigrettes, III, 303.
- Aix sponsa, III, 180.
- Ajaia ajaia, III, 161.
- Alaska, big game of, II, 202, 228.
 " Commercial Company, I, 127.
- Alaudidae, Family, II, 330.
- Albacore, Great, IV, 197.
- Albatross, Black-Footed, III, 235, 237, 238.
 " Short-Tailed, III, 238.
 " Slaughter on Laysan Island, III, 241.
- Albatross, Wandering, III, 234.
- Alca torda, III, 271.
- Alcedinidae, Family, III, 26.
- Alces americanus, II, 4, 108, 120.
 " gigas, II, 230.
- Alligator, Chinese, IV, 24.
 " Mississippi, IV, 13, 17, 22.
- Alopias vulpes, IV, 313.
- Alosa sapidissima, IV, 247.
- Alouatta, I, 11.
- Ambergris, II, 145.
- Ambloplites rupestris, IV, 180.
- Amblyrhynchus cristatus, IV, 54.
- Amblystoma mavortium, IV, 143.
 " opacum, IV, 147.
 " punctatum, IV, 147.
- Ameiurus nebulosus, IV, 271.
- Amia calva, IV, 290.
- Ammospermophilus leucurus, I, 194.
- Ampelis cedrorum, II, 292.
 " garrulus, II, 290.
- "Amphibia and Reptiles," Gadow's book on, IV, 143.
- Amphibians, Bird's-eye view of, IV, 124, 125.
 " Order of Tailed, IV, 124, 142.
 " Order of Worm-Like, IV, 124, 156.
- Amphioxus, IV, 324.
- Amphiuma means, IV, 152.
- Anaconda, IV, 76.
- Anas boschas, III, 174.
 " obscura, III, 172.
- Ancistrodon contortrix, IV, 110.
 " piscivorus, IV, 110.
- Angel Fish, IV, 193.
- Angler, IV, 277.
- Anguilla vulgaris, IV, 232.
- Anhinga anhinga, III, 225.
- Anser albifrons gambeli, III, 206.
- Anseres, Order, II, 255.
- Ant-"Bear," II, 171.
- Ant-Eater, Great, II, 171.
 " Tamandua, II, 175.
- Antelope, Prong-Horned, II, 4, 49, 206.
 " Squirrel, I, 194.
- Antilocapra americana, II, 49.
- Antlers, II, 57.
 " Caribou, II, 104, 105.
 " Moose, II, 112, 115, 118.
 " Mule-Deer, II, 73, 74.
 " Record Elk, II, 71.
- Antrostomus vociferus, III, 5.
- Antrozous pallidus, I, 159.
- Apes and Monkeys, Order of, I, 9.
 " Anthropoid, I, 10.
- Aplodontia rufa, I, 212.
- Apoda, Order, IV, 156.
- Aptenodytes fosteri, III, 273.

- Apteryx australis*, III, 279.
Aquila chrysaetos, III, 63.
Ara ararauna, III, 32.
Archaeopteryx, IV, 6.
 Arctic Province," "Our, I, 127.
Arctonetta fischeri, III, 195, 201.
Ardea caerulea, III, 152.
 " *herodias*, III, 150.
Ardetta exilis, III, 159.
Armadillo, Giant, II, 165.
 " *Nine-Banded*, II, 165, 170.
 " *Six-Banded*, II, 165.
 " *Three-Banded*, II, 165, 170.
 Army of destruction, III, 291.
Aromochelys odoratus, IV, 33.
Artiodactyla, I, 4.
Arvicola, I, 222.
Asio accipitrinus, III, 40.
 " *wilsonianus*, III, 39.
Aspidonectes ferox, IV, 43.
Astragalinus tristis, II, 300.
Atalapha cinerea, I, 173.
Ateles ater, I, 11, 32.
 Auk Family, III, 264.
 " *Great*, III, 271, 283.
 " *Razor-Billed*, III, 271.
 Auklet, Cassin's, III, 271.
 " *Least*, III, 271.
 " *Rhinoceros*, III, 271.
Axolotl, IV, 143.
Aye-Aye, I, 11.
Aythya americana, III, 185.
 " *collaris*, III, 173.
 " *marila*, III, 172.
 " *vallisneria*, III, 187.
 Austin, Mrs. Mary, Poem by, III, 143.
 Baboons, I, 10, 29.
 " *Gelada*, I, 10, 28.
 Badger, I, 82.
 Bailey, Mrs. Florence Merriam, II, 326; III, 76.
 Bailey, Vernon, I, 247, 269, 270.
 Baird, Prof. Spencer F., IV, 165.
 Baker, Arthur B., I, 204.
 " *Dr. Frank*, II, 13.
Balaena glacialis, II, 144.
 " *mysticetus*, II, 142.
 " *sieboldii*, II, 144.
Balaenoptera physalus, II, 144.
 " *sulfureus*, II, 140.
Balistes capricus, IV, 254.
 Barren Grounds of Northern Canada," "The, II, 103.
 Barrett, Mrs. A. W., IV, 187.
 Bass and Sun-Fish Family, IV, 177.
 " *Calico or Strawberry*, IV, 180.
 " *Large-Mouthed Black*, IV, 179.
 " *Rock*, IV, 180.
 " *Small-Mouthed Black*, IV, 179.
 " *Striped*, IV, 188.
 " *Warmouth*, IV, 180.
Bassariscus astutus, I, 110.
Bassarisk, I, 110.
 Bat, Big-Eared, I, 173.
 " *Blainville's Flower-Nosed*, I, 164.
 " *Bonneted*, I, 167, 169.
 " *California Leaf-Nosed*, I, 164.
 " *False Vampire*, I, 162, 174.
 " *Fruit*, I, 162, 177.
 " *Gray*, I, 173.
 " *Great Vampire*, I, 168.
 " *Hammer-Headed*, I, 178.
 " *Horseshoe*, I, 174.
 " *Javelin*, I, 166.
 " *Leaf-Nosed*, I, 163.
 " *Long-Eared*, I, 173.
 " *Naked*, I, 169.
 " *Pale*, I, 159.
 " *Red*, I, 171.
 " *True Vampire*, I, 162, 166.
 Bates, H. W., I, 168.
 Batrachia. *See* Amphibia.
 Bats, Order of, I, 156, 163.
 Bayne Law, II, 244.
 Beal, F. E. L., II, 319; III, 13.
 Bean, Dr. T. H., IV, 275.
 Bear, Big Brown, I, 87, 91; II, 234.
 " " *Admiralty Island*, I, 87.
 " " *Kadiak*, I, 87, 91; II, 233.
 " " *Merriam's*, I, 87.
 " " *Peninsula*, I, 87.
 " " *Sitka*, I, 87.
 " " *Yakutat*, I, 87.
 " *Black*, I, 85, 87, 101; II, 235.
 " " *Cinnamon*, I, 101.
 " " *Everglade*, I, 87.
 " " *Glacier*, I, 87, 102.
 " " *Labrador*, I, 87.
 " " *Louisiana*, I, 87.
 " " *Queen Charlotte*, I, 87.
 " *Family*, I, 82.

- Bear, Grizzly, I, 87, 93; II, 232.
 " " Alaskan, I, 87.
 " " Barren-Ground, I, 87.
 " " Silver-Tip, I, 87.
 " " Sonora, I, 87.
 " Inland White, I, 87, 105, 107.
 " Polar, I, 88.
 " Spectacled, I, 105.
 Beard, J. Carter, IV, 319.
 Beaver, American, I, 180, 212.
 " Mountain, I, 212.
 Beck, R. J., IV, 54.
 Bee-Bird, II, 331.
 Beluga, II, 146.
 Bent, A. C., III, 162.
 Bering, Capt. Vitus, II, 164.
 Big-Horn or Rocky Mt. Sheep, II, 25, 28.
 Biological Survey, II, 259.
 Bird Destruction, II, 239.
 " Frigate, III, 231.
 " Skeleton of, II, 259.
 " Snake, III, 225.
 Bird Life, Decrease in, II, 240.
 Bird World, An Introduction to the, II, 239.
 Bird-collecting condemned, II, 245.
 Birds and Mammals, The Destruction of, II, 239.
 Birds, Chart of, II, 253.
 " Fully Palmated, III, 213.
 " Man-o'-War, III, 231.
 " Orders of, II, 255.
 " Protection of, II, 244.
 " Study of, II, 246, 249.
 " Swimming, III, 167.
 " Weak-Winged Diving, III, 259.
 " Web-Footed, III, 167.
 Bison, American, II, 5-14.
 Bittern, American, III, 157.
 " Least, III, 159.
 Blackbird, Crow, II, 318.
 " Red-Winged, II, 313.
 " Yellow-Headed, II, 314.
 Blackfish, II, 147.
 Black-Gill Sunfish, IV, 185.
 Blarina brevicauda, I, 155.
 Bluebird, II, 265.
 Bluefish, IV, 193.
 Boa Constrictor, IV, 74.
 Bob-Cat, I, 50, 52.
 Bobolink, II, 310.
 Bob-White, II, 241; III, 98.
 Boidae, IV, 74.
 Bonasa umbellus, III, 106.
 Booby Gannets, III, 231.
 Bos americanus, II, 3-14.
 Botaurus lentiginosus, III, 157.
 Bothrops lanceolatus, IV, 115.
 Bovidae, II, 4.
 Brachistoma caribaueum, IV, 324.
 Bradypodidae, II, 175.
 Bradypus tridactylus, II, 177.
 Brant, Black, III, 205.
 Branta bernicla, III, 205.
 " canadensis, III, 200, 205.
 " nigricans, III, 205.
 Breeding Deer, II, 221.
 " Foxes, I, 62.
 " Laws in, II, 221.
 " Mink, I, 70.
 Bronson, E. B., I, 109.
 Brown, William Harvey, IV, 16.
 Bryan, W. A., III, 245.
 Bubo virginianus, III, 46.
 Buffalo, American, II, 3-14.
 " Fishes, IV, 260.
 Bufo lentiginosus, IV, 138.
 Bullhead, Common, IV, 271.
 Bunting, Indigo, II, 310.
 " Snow, II, 301.
 Burroughs, John, III, 267.
 Bushmaster, IV, 106.
 Butcher-Bird, II, 288.
 Buteo borealis, III, 64.
 " lineatus, III, 66.
 Butorides virescens, III, 150.
 Cacomistle, I, 110.
 Caecilians, Family of, IV, 156.
 Caenolestes, II, 185.
 Caiman, Banded, IV, 11.
 " Black, IV, 11, 21.
 " Broad-Nosed, IV, 11.
 " Eye-Browed, IV, 21.
 " Rough-Backed, IV, 11, 22.
 " sclerops, IV, 11.
 Callithrix jacchus, I, 36.
 Callospermophilus lateralis, I, 194.
 Callotaria ursina, I, 123.
 Calmette, Dr., treatment of snake wounds by, IV, 120.
 Camp-Fire Club of America, I, 132.
 "Camudie" (boa constrictor), IV, 79.

- Canachites canadensis canace, III, 110.
 Canidae, I, 40, 53.
 Canis latrans, I, 56.
 " occidentalis, I, 54.
 Caprimulgidae, Family, III, 4.
 Capromys pilorides, I, 250.
 Capuchin, I, 11, 30.
 Capybara, I, 259.
 Carcajou, I, 74.
 Carcharias caeruleus, IV, 313.
 Carcharodon carcharias, IV, 313.
 Cardinal, II, 307.
 Cardinalis cardinalis, II, 307.
 Caribou, II, 87, 224.
 " Barren-Ground, II, 97, 225.
 " Black-Faced, II, 94.
 " Grant's, II, 99.
 " Greenland, II, 99.
 " Kenai, II, 95.
 " Mountain, II, 94.
 " Newfoundland, II, 94, 224.
 " Osborn's, II, 94.
 " Peary's, II, 99.
 " Woodland, II, 90, 94, 225.
 Carnivora, I, 4.
 Carp, IV, 261.
 " Minnows, and Suckers, Order of, IV, 257.
 Cassowary, Ceram, III, 279.
 Castor canadensis, I, 180, 212.
 Casuarus galeata, III, 278.
 Catbird, II, 274.
 Catfish, Channel, IV, 270.
 " Mississippi, IV, 270.
 Catfishes, Order of, IV, 268.
 Catharista urubu, III, 75.
 Cathartes aura, III, 74.
 Catostomus commersoni, IV, 258.
 Cattle and Sheep Family, II, 3.
 Cavy, Spotted, I, 259.
 " Patagonian, I, 261.
 Cebidae, I, 11, 30.
 Cebus hypoleucus, I, 11, 30.
 Cedar Bird, II, 292.
 Centrocercus urophasianus, III, 117.
 Ceratodus forsteri, IV, 174.
 Cercopithecus diana, I, 10, 27.
 Cerorhinca monocerata, III, 271.
 Certhia familiaris americanus, II, 272.
 Cervus canadensis, II, 4, 66, 70, 218.
 Ceryle alcyon, III, 26.
 Cetaceans, II, 139.
 Cete, I, 4.
 Cetorhinus maximus, IV, 313.
 Chaenobryttus gulosus, IV, 180.
 Chaetura pelagica, III, 6.
 Chaparral Cock, III, 24.
 Charadrius dominicus, III, 131.
 Charitonetta albeola, III, 189.
 Chart of Birds, II, 253.
 " Mammals, I, 7.
 Chat, Yellow-Breasted, II, 284.
 Chauleasmus strepera, III, 172.
 Cheiromeles torquatus, I, 169.
 Chelone imbricata, IV, 46.
 " mydas, IV, 45.
 Chelonia, Order, IV, 25, 27.
 Chelopus insculptus, IV, 37.
 " marmoratus, IV, 36.
 Chelydra serpentina, IV, 40.
 Chelydridae, Family, IV, 39.
 Chelys fimbriata, IV, 41.
 Chen hyperborea, III, 206.
 Chickadee, II, 269.
 Chicken, Eastern Prairie, III, 115.
 " Prairie, III, 111.
 Chigwiri, I, 259.
 Chilomycterus geometricus, IV, 256.
 Chimera collei, IV, 306.
 Chimeras, Order of, IV, 306.
 Chimpanzee, I, 5, 10, 15.
 Chinchilla, I, 254.
 " lanigera, I, 254.
 Chipmunk, California, I, 193.
 " Eastern, I, 191.
 " Western, I, 194.
 Chiroptera, I, 4.
 Choloepus hoffmani, II, 178.
 Chordeiles virginianus, III, 4.
 Chrysemys picta, IV, 35.
 Chubs, IV, 264.
 Chuck-Will's-Widow, III, 6.
 Ciconiidae, III, 159.
 Cinclus mexicanus, II, 278.
 Circus hudsonius, III, 70.
 Cistudo carolina, IV, 31.
 Citellus franklini, I, 198.
 " richardsoni, I, 200.
 " tridecemlineatus, I, 197.
 Civet Cat, I, 110.
 Clangula islandica, III, 173.
 Cobra-de-Capello, IV, 96.
 Cobra, Hooded, IV, 96.

- Cobra, King, or Snake-Eating, IV, 98.
 Coccyges, Order, III, 22.
 Coccyzus americanus, III, 22.
 Cockatoo, III, 32.
 Coelogenys paca, I, 259.
 Colaptes auratus luteus, III, 14.
 Colinus virginianus, III, 98.
 Collins, Capt. J. W., III, 230.
 Coluber guttatus, IV, 85.
 Columba fasciata, III, 89.
 Columbæ, Order, III, 84.
 Condor, III, 81.
 " California, III, 76.
 Conepatus, I, 81.
 Coney, II, 126.
 Congo "Snake," IV, 152.
 Congress, II, 220.
 Conurus carolinensis, III, 29.
 Coot, III, 146.
 Copperhead, IV, 110.
 Coregonus clupeiformis, IV, 250.
 Cormorant, III, 222.
 " Double-Crested, III, 225.
 " Pallas's, III, 225, 284.
 Corvus americanus, II, 328.
 " corax sinuatus, II, 329.
 Corynorhinus macrotis, I, 173.
 Coryphaena hippurus, IV, 208.
 Cotton-Mouth Moccasin, IV, 110.
 Cotton-Tail Rabbit, I, 267.
 Cougar, I, 44.
 Cow-"Fish," II, 147.
 Coyote, I, 56.
 Coypu Rat, I, 244.
 Crane, Sandhill, III, 142.
 " Whooping, III, 139.
 Crappie, IV, 184.
 Creeper, Brown, II, 272.
 Cristivomer namaycush, IV, 224.
 Crocodile, American, IV, 21.
 " Australian, IV, 11.
 " Broad-Nosed African, IV, 11.
 " Cuban, IV, 20.
 " Florida, IV, 13, 18.
 " Nile, IV, 11.
 " Orinoco, IV, 13, 21.
 " Salt-Water, IV, 11.
 " Sharp-Nosed African, IV, 11.
 Crocodiles and Alligators, Man-Eating, IV, 16.
 Crocodiles and Alligators, Nesting Habits of,
 IV, 16.
 Crocodiles and Alligators, Order of, IV, 10.
 Crocodilia, Order, IV, 10.
 Crocodilus acutus, IV, 18.
 " cataphractus, IV, 11.
 " acutus floridanus, IV, 18.
 " intermedius, IV, 13, 21.
 " johnstoni, IV, 11.
 " niloticus, IV, 11.
 " palustris, IV, 13.
 " porosus, IV, 11.
 " rhombifer, IV, 20.
 Crossbill, American, II, 300.
 Crotalus adamanteus, IV, 103.
 " atrox, IV, 103.
 " cerastes, IV, 106.
 " confluentus, IV, 100.
 " horridus, IV, 104.
 " lepidus, IV, 100.
 " lucifer, IV, 100.
 " mitchelli, IV, 100.
 " molossus, IV, 100.
 " tigris, IV, 100.
 Crotaphytus collaris, IV, 61.
 Crow, Clarke's, II, 327.
 " Common, II, 328.
 Crowley, J. B., I, 129.
 Cryptobranchus alleghaniensis, IV, 150.
 " maximus, IV, 151.
 Cuckoo, Black-Billed, III, 23.
 " Yellow-Billed, III, 22.
 "Culebra de Agua" (anaconda), IV, 79.
 Curlew, Eskimo, III, 284.
 " Long-Billed, III, 136.
 Cyanocephalus cyanocephalus, II, 325.
 Cyanocitta cristata, II, 323.
 " stelleri, II, 324.
 Cyanospiza cyanea, II, 310.
 Cynomys ludovicianus, I, 201.
 Cyprinus carpio, IV, 261.
 Cyrtonyx montezumae mearnsi, III, 105.
 Cystophora cristata, I, 138.
 "Dabchick" (grebe), III, 261.
 Dactylopterus volitans, IV, 253.
 Dafila acuta, III, 179.
 Darter, III, 225.
 Dasypsecta agouti, I, 258.
 Dasypus trinctus, II, 170.
 Dasyures, II, 185.
 Deer, Arizona White-Tailed, II, 80.
 " breeding, II, 222.

- Deer, Columbian Black-Tailed, II, 77, 224.
 " damages by, II, 86.
 " dangerous, II, 61, 65.
 " Family, II, 4, 55.
 " Florida White-Tailed, II, 80.
 " "Jumping," II, 76.
 " Mule or "Black-Tailed," II, 72, 223.
 " Sitka, II, 78.
 " White-Tailed, or Virginia, II, 78.
- Delphinapterus leucas, II, 146.
 Delphinus delphis, II, 154.
 Dendragapus obscurus, III, 109.
 Dendrocygna fulva, III, 172.
 Dendroica aestiva, II, 283.
 Desmognathus fusca, IV, 147.
 Devil-Fish, IV, 318.
 De Weese, Dall, II, 120.
 Diana Monkey, I, 10, 27.
 Dickerson, Mrs. E. N., IV, 199.
 Microstonyx hudsonius, I, 221.
 Didelphis virginiana, II, 190.
 Diedipper (grebe), III, 261.
 Diemyctylus viridescens, IV, 148.
 Diggers, Order of the, II, 180.
 Dill, Homer R., III, 246.
 Dimock, A. W. and J. A., IV, 247.
 Diomedea albatrus, III, 238.
 " chinensis, III, 238.
 " exulans, III, 234.
 " nigripes, III, 237.
- Dipodomys merriami, I, 222.
 Dipper, II, 278.
 Ditmars, Raymond L., IV, 5, 80, 82, 86, 131.
 Diver, Great Northern, III, 262.
 Divers, Order of Flightless, III, 273.
 " Order of Weak-Winged, III, 259.
- Dixon, Senator J. M., I, 135.
 Dog Family, I, 40, 53.
 Dogfish, IV, 290.
 Dolichonyx oryzivorus, II, 310.
 Dolichotis patachonica, I, 261.
 " Dolphin," IV, 208.
 Dolphin, Common, II, 154.
 Dolphin and Porpoise Family, II, 152.
 Doroucoulis, I, 33.
 Dove, Mourning, III, 91.
 Dromæus novaehollandæ, III, 278.
 Dryobates villosus, III, 19.
 Duck, American Scoter, III, 173.
 " American Widgeon, III, 172.
 " Barrow's Golden-Eye, III, 173.
- Duck, Black, III, 172.
 " Blue-Winged Teal, III, 176.
 " Buffle-Head or Butter-Ball, III, 189.
 " Canvasback, III, 187.
 " Cinnamon Teal, III, 177.
 " Eider, III, 193.
 " Fulvus Tree, III, 172.
 " Gray, III, 172.
 " Green-Winged Teal, III, 177.
 " Harlequin, III, 173.
 " Hooded Merganser, III, 199, 201.
 " Labrador, III, 283.
 " Mallard, III, 169, 174.
 " Merganser, III, 201.
 " Old Squaw, III, 173.
 " Pintail or Sprigtail, III, 181.
 " Red-Breasted Merganser, III, 196.
 " Red-Head, III, 185.
 " Ring-Necked, III, 173.
 " Ruddy, III, 201.
 " Scaup, III, 172.
 " Shoveller or Spoonbill, III, 177.
 " Spectacled Eider, III, 195.
 " Steller's, III, 201.
 " Surf Scoter, III, 173.
 " White-Winged Scoter, III, 195.
 " Wood, III, 180.
- Duck-Bill, II, 196.
 Ducks, Geese, and Swans, Order of, III, 167.
 Dugong, II, 159, 163.
 Dutcher, William, II, 261; III, 254.
 Dyche, Prof. L. L., I, 56, 117, 118, 146, 267;
 II, 69; IV, 167.
- Eagle, Bald, III, 35, 60.
 " Golden, III, 63.
- Ecaudata, Order, IV, 129.
 Echidnas, II, 196.
 Ectopistes migratorius, III, 84.
 Edentata, Order, I, 4; II, 165.
 Education, Bureau of, II, 107.
 Eel, Common, IV, 282.
 " Electric, IV, 283.
 " Lamper, IV, 285.
- Effodientia, Order, I, 4; II, 180.
 Egg-collecting, II, 245.
 Egret, American, III, 157, 303.
 " Snowy, III, 154, 303.
- Egretta candidissima, III, 154.
 Eider, American, III, 193.
 " King, III, 201.

- Eider, Spectacled, III, 195, 201.
 Eigenmann, Dr. C. H., I, 161.
 Elanoides forficatus, III, 72.
 Elaps euryxanthus, IV, 115.
 " fulvius, IV, 114.
 Elephants, Order of, II, 129.
 " African, II, 134.
 " Indian, II, 137.
 " Pygmy, II, 137.
 Elephas columbi, II, 132.
 " imperator, II, 132.
 " indicus, II, 137.
 " oxyotis, II, 134.
 " primigenius, II, 129.
 " pumilio, II, 137.
 Elk, or Wapiti, II, 4, 66, 218.
 Elk's Calendar, II, 60.
 Ellachick, IV, 36.
 Elliot, D. G., I, 180; III, 211.
 Elliott, Henry W., I, 88, 124, 127, 136.
 " William, IV, 319.
 Emu, III, 278.
 Eniconetta stelleri, III, 201.
 Epomophorus, I, 178.
 Erethizon dorsatus, I, 252.
 " epixanthus, I, 253.
 Eremetes pusillus, III, 134.
 Erignathus barbatus, I, 137.
 Erismatura jamaicensis, III, 201.
 Eschricht, D. F., II, 151.
 Esox lucius, IV, 215.
 " masquinongy, IV, 215.
 " ohioensis, IV, 216.
 " reticulatus, IV, 216.
 Eumeces quinquelineatus, IV, 58.
 Eumetopias stelleri, I, 120.
 Eunectes murinus, IV, 76.
 " notaeus, IV, 77.
 Eupotomis gibbosus, IV, 185.
 Eutaenia sirtalis, IV, 90.
 Eutamias quadrivittatus, I, 194.
 " speciosus, I, 193.
 Evermann, Dr. Barton W., IV, 159, 225, 231.
 Evotomys gapperi, I, 228.
 " rutilus, I, 228.
 Exocactus volitans, IV, 252.
 Extermination defined, III, 281.
 " methods of, III, 290.
 " of Antelope, II, 206.
 " of Bear, II, 232.
 " of Birds, II, 240; III, 283-289.
 Extermination of Elk, II, 218.
 " of Grouse, II, 242.
 " of Mammals, II, 199.
 " of Mtn. Sheep, II, 209.
 " of Musk-Ox, II, 231.
 Falco columbarius, III, 59.
 " peregrinus anatum, III, 59.
 " sparverius, III, 58.
 Felis concolor, I, 44.
 " onca, I, 40.
 " pardalis, I, 48.
 Ferae, Order, I, 4, 40.
 Fer-de-Lance, or Lance-Head Snake, IV, 115.
 Ferret, Black-Footed, I, 71.
 Fiber zibethicus, I, 220, 245.
 Fighting Deer, II, 65.
 Finches, II, 299.
 Fish, Angel, IV, 193.
 " Angler, or Goose, IV, 277.
 " Bellows, or Rabbit, IV, 256.
 " Blue Cat-, IV, 270.
 " Box, or Trunk, IV, 255.
 " Buffalo, IV, 260.
 " Channel Cat-, IV, 270.
 " Devil, IV, 318.
 " Eggs, IV, 166.
 " File, IV, 254.
 " Flying, IV, 252.
 " Gar, or Bill, IV, 294.
 " Grunt, IV, 161.
 " Hag, IV, 323.
 " Hatcheries, IV, 167.
 " Lung, IV, 174.
 " Mud-, IV, 176.
 " Paddle, IV, 303.
 " Porcupine, IV, 256.
 " Sucking, IV, 212.
 " Trigger, or File, IV, 254.
 " White, IV, 250.
 Fish Commission, U. S. (*see* Fisheries Bureau), IV, 165.
 Fisher, Dr. A. K., III, 38.
 " I, 74.
 Fisheries, U. S. Bureau of, IV, 165.
 Fishery Industries of the United States, IV, 164.
 Fishes, Class of, IV, 159, 172, 173.
 " Game, of North America, IV, 208.
 " Order of Flat-, IV, 173, 273.
 " Order of Foot-, IV, 173, 277.

- Fishes, Order of Gar or Ganoid, IV, 173.
 " Order of Half-Gilled, IV, 172.
 " Order of Solid-Jaw, IV, 172.
 " Order of Spiny-Finned, IV, 172, 177.
 " Pipe-, and Sea-Horses, IV, 173.
 Fishes," "Descriptive Catalogue of, IV, 159.
 "Fishes of North and Middle America," IV, 323.
 Fish-Hawk, III, 54.
 Flamingo, American, III, 164.
 Flicker, III, 15.
 Flounder, Winter, IV, 274.
 Flycatchers, II, 331.
 Flying Fish, IV, 252.
 Flying Gurnard, IV, 253.
 Food and Game Fishes," "American, IV, 303.
 Fool Hen, III, 110.
 Fox, Arctic, I, 63.
 " Black, I, 61.
 " Blue, I, 64.
 " Coast Gray, I, 59.
 " Cross, I, 60.
 " Florida Gray, I, 59.
 " Flying, I, 177.
 " Gray, I, 65.
 " Hall Island, I, 58.
 " Kadiak, I, 58.
 " Kit, I, 63.
 " Large-Eared, I, 58.
 " Newfoundland, I, 58.
 " Red, I, 59.
 " Scott's Gray, I, 59.
 " Silver, I, 61.
 " Swift, I, 63.
 " Texas Gray, I, 59.
 " Townsend's Gray, I, 59.
 Fratercula arctica, III, 270.
 Fregata aquila, III, 231.
 Frigate-Bird, III, 231.
 Fringillidae, II, 299.
 Frog, Bull, IV, 135.
 " Common, IV, 131, 134.
 " Leopard, IV, 133.
 " Northern Tree, IV, 138.
 " Smith, IV, 137.
 " Tongueless, IV, 140.
 " Tree, IV, 136.
 " Wood, IV, 136.
 Frogs and Toads, Order of, IV, 129.
 Fulica americana, III, 146.
 Fulmar Family, III, 239.
 Fur Seal, I, 123-136.
 Fur-Bearers, The Small, I, 66.
 Gadwall, III, 172.
 Galeocerdo tigrinus, IV, 312.
 Galeoscoptes carolinensis, II, 276.
 Gallinae, Order, III, 96.
 Gallinago delicata, III, 133.
 Gallinula galeata, III, 145.
 Gallinule, Florida, III, 145.
 " Purple, III, 145.
 Game Birds, Order of Upland, III, 96.
 Game for revenue, II, 84.
 Game-hog, III, 291.
 Gannet, III, 228.
 Ganoids, Order of, IV, 293.
 Gar, Alligator, IV, 295.
 Gar Pike, Long-Nosed, IV, 294.
 " Short-Nosed, IV, 295.
 Gardiner's Island, Ospreys on, III, 56.
 Garrupa nigrita, IV, 188.
 Gasterosteus aculeatus, IV, 267.
 Gavia imber, III, 262.
 Gavial, Indian, IV, 13.
 Gavialis gangeticus, IV, 10, 13.
 Geese, Ducks, and Swans, III, 167.
 Gelada Baboon, I, 10, 28.
 Geococcyx californianus, III, 24.
 Geomys bursarius, I, 180, 245.
 Gibbons, I, 10, 22, 25.
 Gila Monster, IV, 62.
 Gilfort, Robert, II, 136.
 Glass "Snake," IV, 65.
 Glires, I, 4, 180.
 Globicephala melas, II, 147.
 Glutton, I, 74.
 Glyptodon, II, 166.
 Glyptotherium texanum, II, 166.
 Gnawing Animals, Order of, I, 180.
 Goat, Rocky Mountain, or White, II, 41, 216.
 Goatsuckers, III, 4.
 Goldfinch, American, II, 300.
 "Gonies" (Albatross), III, 237.
 Goode, G. Brown, II, 146, 147; IV, 188, 197, 207, 221.
 Goose, American White-Fronted, III, 206.
 " Black Brant, III, 205.
 " Brant, III, 205.
 " Cackling, III, 205.
 " Canada, III, 200.
 " Hutchins's, III, 205.

- Goose, Snow, III, 206.
 " White-Cheeked, III, 205.
- Goosefish, IV, 277.
- Gopher Family, Pocket, I, 180, 245, 269.
 " Red Pocket, I, 245.
- Gorilla, I, 10, 12, 13.
- Goshawk, American, III, 70.
- Grackle, Purple, III, 318.
- Grampus, II, 147.
 " griseus, II, 147.
- Grant, Madison, II, 105.
- Graptemys pseudogeographicus, IV, 26.
- Gray Duck, III, 172.
- Grebe, Pied-Billed, or Carolina, III, 260.
- Greely, Gen. A. W., II, 19.
- Grinnell, George B., IV, 233.
 " Joseph, III, 78.
- Grosbeak, Cardinal, II, 307.
 " Rose-Breasted, II, 308.
- Ground-"Hog," I, 208.
- Grouper, Black, IV, 188.
- Grouse, Blue, III, 109.
 " Canada Spruce, III, 110.
 " Canadian Ruffed, III, 109.
 " Dusky, III, 109.
 " Family, III, 97.
 " Franklin, III, 110.
 " Gray Ruffed, III, 109.
 " Oregon, or Sabine's, III, 109.
 " Pine, III, 109.
 " Pinnated, III, 111.
 " Prairie Sharp-Tailed, III, 117.
 " Ruffed, III, 106.
 " Sage, III, 117.
 " Sooty, III, 110.
- Gruber, Peter, IV, 121.
- Grunt, Black, IV, 161.
- Grus americana, III, 139.
 " mexicana, III, 142.
- Guara alba, III, 160.
 " rubra, III, 160.
- Guillemots, III, 264.
- Gull, Herring, III, 249.
- Gulo luscus, I, 74.
- Gurnard, Flying, IV, 253.
- Gymnogyps californianus, III, 76.
- Gymnotus electricus, IV, 283.
- Haemulon plumieri, IV, 161.
- Hagenbeck's Sons, Carl, I, 90.
- Haliaeetus leucocephalus, III, 60.
- Halibut, Common, IV, 274.
- Hallock, Charles, IV, 291.
- Hamilton, Maj. J. Stevenson-, II, 233.
- Hang-Nest, II, 316.
- Hare and Rabbit Family, I, 181, 262.
- Hare, Jack, I, 267.
 " Little Chief, or Crying, I, 261.
 " Northern Varying, I, 263.
 " Polar, I, 266.
 " Prairie, I, 266.
- Harelda hyemalis, III, 173.
- Harlequin Snake, IV, 114.
- Harporhynchus rufus, II, 275.
- "Haven of Refuge," for Ducks, III, 191.
- Hawk and Eagle Family, III, 53.
- Hawk, Chicken, III, 64.
 " Cooper's, III, 68.
 " Duck, III, 59.
 " Fish, III, 54.
 " Forked-Tailed, III, 72.
 " Hen, III, 64.
 " Marsh, III, 70.
 " Pigeon, III, 59.
 " Red-Shouldered, III, 66.
 " Red-Tailed, III, 64
 " Sharp-Shinned, III, 67.
 " Sparrow, III, 58.
- Heath Hen, III, 115.
- Hellbender, IV, 150.
- Hell-Diver (grebe), III, 260.
- Heloderma suspectum, IV, 62.
- Herodias egretta, III, 157.
- Herodiones, Order, III, 148.
 " Black-Crowned Night, III, 152.
- Heron Family, III, 150.
 " Great Blue, III, 150.
 " Little Blue, III, 152.
 " Little Green, III, 150.
 " Snowy, III, 154.
- Herring Gull, III, 249.
- Hesperornis, IV, 6.
- Heterodon platyrhinus, IV, 93.
- Heteromyidae, Family, I, 222.
- Heterosomata, IV, 273.
- Hippocampus heptagonus, IV, 239.
- Hippoglossus hippoglossus, IV, 274.
- Hirundo erythrogastra, II, 297.
- Histrionicus histrionicus, III, 190.
- Histiophoca fasciata, I, 138.
- Holacanthus ciliaris, IV, 193.
- Holder, C. F., IV, 198.
- Holland, W. J., III, 277.
- Homo sapiens, I, 13.

- Hoofed Animals, Order of, II, 3.
Hornaday, W. T., II, 13, 240.
Horned "Toad," IV, 63.
Horns, Mountain Sheep, II, 38.
" Prong-Horned Antelope, II, 49.
Hoy, Dr. P. R., I, 198.
Humming-birds, III, 7-10.
" Ruby-Throated, III, 8.
Hunting-grounds for big game, II, 204.
Hutias, I, 181, 249.
Hydrodamalis, II, 159.
Hyla faber, IV, 137.
" versicolor, IV, 138.
Hylobates leuciscus, I, 10, 22.
Hyllocichla mustelina, II, 264.
Hyracoidea, I, 4.
Hyrax, Cape, II, 126.
Hyrax capensis, II, 126.
- Ibis Family, III, 160.
" Glossy, III, 161.
" Scarlet, III, 160.
" White, III, 160.
" Wood, III, 159.
- Icteria virens, II, 284.
Icterus galbula, II, 316.
Ictiobus cyprinella, IV, 26C.
Ictulurus furcatus, IV, 270.
" punctatus, IV, 270.
- Iguana, Common, IV, 54.
" Marine, IV, 54.
" Rhinoceros, IV, 57.
- Impennes, Order, II, 255; III, 167, 273.
In-breeding, II, 222.
Insectivora, Order, I, 148.
Ionornis martinica, III, 145.
Italians, II, 240.
- Jackson, Chester E., IV, 18.
Jaeger, Parasitic, III, 257.
Jaegers and Skuas, III, 257.
Jaguar, I, 40.
Japanese pelagic sealers, I, 131, 132.
" Red-Faced Monkey, I, 26.
- Javelina Peccary, II, 122.
Jay, Blue, II, 323.
" Canada, II, 327.
" Pinon, II, 325.
" Steller's, II, 324.
- Jewfish, IV, 186.
Jones, C. J., I, 55.
- Jones, J. Walter, I, 71.
Jordan, Dr. David S., IV, 159, 219, 221, 231.
Judd, Sylvester D., III, 102.
Jumbo, II, 133, 135.
Jumping Mouse Family, I, 243.
Junco hyemalis, II, 302.
" Slate-Colored, II, 302.
- Kangaroo, II, 187-189.
" Gray, II, 187.
" Old Man, II, 187.
" Rat, II, 187.
" Red, II, 187.
" Tree, II, 187.
- Kangaroo Rat, I, 241.
Kea, III, 29.
Kermode, Francis, I, 105.
Killer Whale, II, 148.
Kingbird, II, 331.
Kingfisher, Belted, III, 26.
Kinglets, II, 268.
Kite, Swallow-Tailed, III, 72.
Kiwi, III, 279.
Kogia, II, 145.
- Lacertilia, Order, IV, 52.
Lachesis mutus, IV, 106.
Lagocephalus laevigatus, IV, 256.
Lagopus lagopus, III, 123.
" leucurus, III, 123.
Lamna cornubica, IV, 313.
Lamper "Eel," IV, 285, 321.
Lamprey, Brook, IV, 323.
" Sea, IV, 322.
- Lancelets, The, IV, 324.
Lanius borealis, II, 288.
" ludovicianus, II, 288.
- Laridae, III, 249.
Lark, Horned, II, 330.
" Meadow, II, 314, 316.
" Shore, II, 330.
- Larus argentatus, III, 249.
Lasiurus borealis, I, 171.
Latax lutris, I, 68.
Latham, Mrs. C. F., I, 231; IV, 48, 103.
Laysan Island, III, 241.
Leek, S. N., II, 67, 220.
Lemming, I, 221.
" False, I, 226.
" Hudson Bay, I, 221.
" Mouse, Cooper's, I, 226.
" Mouse, or False Lemming, I, 226.

- Lemur varius, I, 37.
 Lemurs, I, 11, 37.
 " Ruffed, or Black and White, I, 37.
 " Suborder of, I, 11, 37.
 Lepidosiren, IV, 176.
 Lepidosteus osseus, IV, 294.
 " platystomus, IV, 295.
 " spatula, IV, 295.
 Lepomis pallidus, IV, 185.
 Leporidae, I, 181, 262.
 Leptocardii, IV, 324.
 Lepus americanus, I, 265.
 " arcticus, I, 266.
 " campestris, I, 266.
 " sylvaticus, I, 267.
 " texianus, I, 267.
 Licenses, Hunting, III, 291.
 Light-House Board, III, 266.
 Limicolae, Order, III, 127.
 Lizard, Blue-Tailed, or Skink, IV, 58.
 " Horned, IV, 63.
 " Ring-Necked, or Kangaroo, IV, 61.
 " Sea, IV, 54.
 Lizards, Order of, IV, 52.
 Lodge, Senator H. C., II, 220.
 Longipennes, Order, III, 167, 249.
 Loon, or Great Northern Diver, III, 262.
 "Lopez," I, 44.
 Lophius piscatorius, IV, 277.
 Lophodytes cucullatus, III, 199, 201.
 Lophortyx californicus, III, 104.
 Loring, J. Alden, I, 92; III, 66.
 Loxia curvirostra minor, II, 300.
 Lucas, Frederic A., I, 130; III, 229, 272.
 Lumpy-Jaw, II, 53.
 Lunda cirrata, III, 270.
 Lung-Fish, Australian, IV, 174.
 Lutianus aya, IV, 206.
 Lutra canadensis, I, 67.
 Lutreola vison, I, 70.
 Lynx, Bay, or Red, I, 50, 52.
 " Canada, I, 49.
 Lynxes, I, 48.

 Macacus speciosus, I, 10, 26.
 McAttee, W. L., III, 127.
 Macaw, Blue and Yellow, III, 32.
 Macaws exterminated, III, 287-288.
 MacDougall, Dr. D. T., II, 121.
 Mackerel, Horse, IV, 197.
 " Spanish, IV, 195.

 Macrochelys temmincki, IV, 39.
 Macrochires, Order, III, 3.
 Macropus giganteus, II, 188.
 " rufus, II, 187.
 Magpie, American, II, 320.
 Malacoclemmys palustris, IV, 36.
 Mammals, Chart of, I, 7.
 " Order of Egg-Laying, II, 196.
 " Order of Flesh-Eating, I, 40.
 " Order of Pouched, II, 185.
 " Order of Toothless, II, 165.
 " Orders of, I, 4.
 Mammoth, Columbian, II, 132.
 " Imperial, II, 132.
 Man, I, 12, 21.
 Manatee, or Sea-Cow, II, 159.
 Mandrill, I, 29.
 Manis pentadactyla, II, 181.
 Man-o'-War Birds, III, 231.
 " "Hawk," III, 231.
 Manta birostris, IV, 318.
 Mareca americana, III, 172.
 Market-hunting, III, 294.
 Marmosa murina, II, 195.
 Marmoset, Common, I, 36.
 " Pinche, I, 35.
 " Silky, I, 36.
 Marmot, I, 200.
 " Gray, or Whistler, I, 208.
 " Olympic, I, 210.
 " Yellow-Bellied, I, 209.
 Marmota flaviventer, I, 209.
 " monax, I, 208.
 " pruinosa, I, 208.
 Marsupialia, Order, I, 4; II, 185.
 Marten Family, I, 40, 66.
 " Pennant's, I, 74.
 " Pine, I, 73.
 Martin, Bee, II, 331.
 " Purple, II, 293.
 Massasauga, IV, 109.
 " Edward's, IV, 100.
 Mastodon, II, 130.
 " americanus, II, 130.
 Matamata, IV, 41.
 Meadow-Lark, II, 314.
 " Western, II, 316.
 Megaderma lyra, I, 162.
 Megaptera nodosa, II, 144.
 Megascops asio, III, 42.
 Megatherium, II, 179.

- Melanerpes erythrocephalus*, III, 15.
 " *formicivorus*, III, 18.
Meleagris gallopavo, III, 125.
 " *ocellata*, III, 126.
Melospiza fasciata, II, 303.
Menobanchus, IV, 154.
Menopoma alleghaniensis, IV, 150.
Mephitis mephitis, I, 77.
Merganser americanus, III, 201.
 " *Hooded*, III, 199, 201.
 " *Red-Breasted*, III, 196.
 " *serrator*, III, 196.
 Merriam, Dr. C. Hart, I, 91, 203, 270; III, 20.
Merula migratoria, II, 260.
Metopoceros cornutus, IV, 57.
 Mexico, II, 216.
 Mice and Rats, *Cheek-Pouched*, I, 240.
 " *Family of*, I, 180, 218.
 " *Typical North American*,
 I, 222.
Micropterus dolomieu, IV, 179.
 " *salmoides*, IV, 179.
Microtus (Arvicola) pennsylvanicus, I, 226.
Midas aedipus, I, 35.
 " *rosalia*, I, 36.
 Millinery, *Bird-slaughter for*, III, 302.
Mimus polyglottos, II, 276.
 Mink, I, 67.
 Minnows, IV, 263.
 Missing Link, I, 21.
 Moccasin, *Water, or Cotton-Mouth*, IV, 110.
 Mockingbird, II, 276.
 Mole, *Common*, I, 150, 151.
 " *Hairy-Tailed*, I, 153.
 " *Prairie, or Silver*, I, 153.
 " *Star-Nosed*, I, 154.
 Monkey, *Black Saki*, I, 34.
 " *Black-Faced Spider*, I, 32.
 " *Capuchin*, I, 30.
 " *Diana*, I, 10, 27.
 " *Golden Howler*, I, 34.
 " *Japanese Red-Faced*, I, 10, 26.
 " *Marmoset*, I, 35.
 " *Mexican Spider*, I, 32.
 " *Owl*, I, 32.
 " *Saki*, I, 33.
 " *Sapajou*, I, 30.
 " *Spider*, I, 30.
 " *Squirrel*, I, 33.
 " *Teetee*, I, 33.
 " *Uakari*, I, 34.
 " *Yarkee*, I, 34.
 Monkeys, *New World*, I, 11, 30.
 " *Old World*, I, 10, 26.
 " *Short-Tailed*, I, 28.
Monodon monoceros, II, 157.
Monotremata, I, 4.
 " *Order*, II, 196.
 Montana *Bison Range*, II, 13.
 Moose, II, 108, 228.
 " *Alaskan*, II, 118.
 Moose-Bird, II, 327.
 Morehouse, *Col. C. P.*, IV, 201.
Mormoops blainvillii, I, 164.
 Morris, Dr. Robt. T., IV, 241.
 " *Mother Carey's Chickens*," III, 239.
 Mountain "Beaver," I, 212.
 " *Lion*, I, 44.
 " *Sheep*, II, 3, 25.
 " " *Big-Horn*, II, 28.
 " " *Black*, II, 34.
 " " *California, or Nelson's*, II,
 32.
 " " *Fannin's*, II, 37.
 " " *Marco Polo's*, II, 38.
 " " *Mexican*, II, 32, 38.
 " " *Pinacate*, II, 31, 38.
 " " *Siar*, II, 38.
 " " *White, or Dall's*, II, 32, 38.
 Mouse, *Cooper's Lemming*, I, 226.
 " *Field*, I, 226.
 " *Gapper's Field*, I, 229.
 " *Grasshopper*, I, 238.
 " *Harvest*, I, 232.
 " *Jumping*, I, 243.
 " *Lemming*, I, 225.
 " *Little Harvest*, I, 232.
 " *Meadow*, I, 226.
 " *Missouri, or Mole*, I, 239.
 " *Pocket*, I, 240, 244.
 " *Red-Backed*, I, 228.
 " *Rice-Field*, I, 233.
 " *White-Footed*, I, 234.
 Mouse and Rat *Family*, I, 218, 222.
 " " " *Cheek-Pouched*, I,
 222, 240.
Moxostoma aureolum, IV, 260.
 Mud "Eel," IV, 155.
 " *Hen*, III, 146.
 " *Puppy*, IV, 153.
 Mugger *Crocodile*, IV, 11.
Mugil brasiliensis, IV, 203.
 Mullet, *White, or Silver*, IV, 203.
 Muridae, I, 222.

- Murre, Brunnich's, III, 266.
 " California, III, 266.
 " Common, III, 266.
 Mus rufescens, I, 245.
 Muskallunge, IV, 215.
 Musk-Ox, II, 14, 231.
 Muskrat, I, 220, 245.
 Mustela americana, I, 73.
 " pennanti, I, 74.
 Mustelidae, I, 40, 67.
 Myocastor coypus, I, 244.
 Myopotamus coypu, I, 250.
 Myrmecophaga jubata, II, 171.

 Naja bungarus, IV, 98.
 " tripudians, IV, 96.
 Nansen, F., III, 273.
 Narwhal, II, 157.
 Nathorst, Prof. A. G., II, 20.
 Natrix fasciata, IV, 92.
 Neanderthal Man, I, 22.
 Necturus maculatus, IV, 153.
 Nelson, E. W., II, 208.
 Neotoma floridana, I, 232.
 Nettion carolinensis, III, 177.
 News, IV, 148.
 " Crimson-Spotted, IV, 148.
 Nice, Margaret M., III, 102.
 Nighthawk, III, 4.
 Night-Heron, Black-Crowned, III, 152.
 Niles, O. E., III, 46.
 Niobrara Bison Range, II, 13.
 North American Commercial Co., I, 128.
 Nucifraga columbiana, II, 325.
 Numenius longirostris, III, 136.
 Nut-Cracker, Clarke's, II, 325.
 Nuthatch, II, 270.
 Nyctala acadica, III, 42.
 Nyctea nyctea, III, 49.
 Nycticorax nycticorax naevius, III, 152.

 Ocelot, I, 48, 51.
 Ochotona princeps, I, 261.
 Odobenus obesus, I, 141.
 " rosmarus, I, 146.
 Odocoileus columbianus, II, 77, 224.
 " hemionus, II, 72, 223.
 " sitkensis, II, 78.
 " virginianus, II, 78.
 Odontoglossae, Order, III, 164.
 Oidemia americana, III, 173.

 Oidemia deglandi, III, 195.
 " perspicillata, III, 173.
 Olds, C. S., IV, 319.
 Olor buccinator, III, 207.
 " columbianus, III, 212.
 Oncorhynchus gorbuscha, IV, 238.
 " keta, IV, 238.
 " kisutch, IV, 237.
 " nerka, IV, 236.
 " tschawwyscha, IV, 235.
 Onychomys leucogaster, I, 238.
 Ophibolus getulus, IV, 83.
 Ophidia, Order, IV, 6.
 Ophiosaurus ventralis, IV, 65.
 Opossum, Murine, II, 195.
 " Virginia, II, 190.
 Orang-Utan, I, 10, 17.
 Orca, II, 148.
 Orcinus orca, II, 146.
 Oreamnos montanus, II, 41.
 Oreortyx pictus, III, 104.
 Oriole, Baltimore, II, 316.
 Ornithorhynchus anatinus, II, 196.
 Orycteropus afer, II, 184.
 Oryzomys palustris, I, 233.
 Osborn, Prof. Henry F., I, 4; II, 166.
 Osgood, W. H., I, 205.
 Osprey, American, III, 54.
 Osteolaemus tetraspis, IV, 11.
 Ostracion quadricornis, IV, 255.
 Ostrich, African, III, 276.
 " South American, III, 277.
 Otocoris alpestris, II, 330.
 Otopterus, californicus, I, 164.
 Otter, I, 67.
 " Sea, I, 68.
 Ouananiche, IV, 242.
 "Outdoor Life" (magazine), I, 45.
 Ouzel, Water, II, 278.
 Ovibos moschatus, II, 14.
 " wardi, II, 18.
 Ovis ammon, II, 38.
 " canadensis, II, 28, 38.
 " dalli, II, 32, 36.
 " " fannini, II, 37.
 " mexicanus, II, 32, 38.
 " nelsoni, II, 32.
 " poli, II, 38.
 " siarensis, II, 38.
 " stonei, II, 34, 38.
 Owl, Barn, III, 34, 37.

- Owl, Barred, III, 40.
 " Burrowing, III, 50.
 " Great Gray, III, 42.
 " Great Horned, III, 46.
 " Horned, Family, III, 39.
 " Long-Eared, III, 39.
 " Monkey-Faced, III, 34.
 " Saw-Whet, III, 42.
 " Screech, III, 42.
 " Short-Eared, III, 40.
 " Snowy, III, 49.
 Owl Monkey, I, 32.
 Oxyechus vocifera, III, 130.
- Paca, I, 259.
 Paddle-Fish, IV, 303.
 Palmer, Dr. T. S., I, 269; II, 207.
 Paludicolae, Order, III, 138.
 Pan troglodytes, I, 10, 15.
 Pandion haliaeetus carolinensis, III, 54.
 Pangolin, Giant, II, 181.
 " Indian, II, 181.
 Parrakeet, Carolina, III, 29.
 " exterminated, III, 288.
 Parrots exterminated, III, 288.
 Parrots and Macaws, Order of, III, 28.
 "Partridge," Black, III, 110.
 Parus atricapillus, II, 269.
 Paschen, H., I, 14.
 Passer domesticus, II, 305.
 Passeres, Order, II, 255.
 Passerina nivalis, II, 301.
 Peary, Commander Robt. E., I, 146; II, 14.
 Peccary, Collared, II, 121.
 " Family, II, 4, 121.
 " White-Lipped, II, 123.
 Pedioecetes phasianellus campestris, III, 117.
 Pelagic sealing, I, 128, 131, 132.
 Pelecanus californicus, III, 218.
 " erythrorhynchos, III, 218.
 " fuscus, III, 213.
 Pelican, Brown, III, 213.
 " California Brown, III, 218.
 " Great White, III, 218.
 " Island, III, 214.
 Penguin, Black-Footed, III, 274.
 " Emperor, III, 273.
 " Pack, III, 274.
 Perca flavescens, IV, 191.
 Perch, Pike-, IV, 192.
 " Yellow, IV, 191.
 Perisoreus canadensis, II, 327.
 Perissodactyla, I, 4.
 Perodipus richardsoni, I, 241.
 Perognathus fasciatus, I, 240.
 " flavus, I, 245.
 Peromyscus leucopus, I, 234.
 Petrel, Stormy, III, 239.
 Petrochelidon lunifrons, II, 297.
 Petrogale penicillata, II, 188.
 Petromyzon marinus, IV, 322.
 Pewee, II, 332.
 Phalacrocorax carbo, III, 222.
 " dilophus, III, 225.
 " pelagicus, III, 225.
 Phalangers, II, 185.
 Phasianus torquatus, III, 124.
 Pheasant Family, III, 97.
 " Golden, III, 125.
 " Ring-Necked, III, 124.
 " Silver, III, 125.
 Phenacomys orophilus, I, 230.
 Phillips, John M., II, 217.
 Philohela minor, III, 132.
 Phoca foetida, I, 137.
 " groenlandica, I, 137.
 " vitulina, I, 137.
 Phocaena communis, II, 154.
 Phoebe Bird, II, 332.
 Phoenicopterus ruber, III, 166.
 Phrynosoma cornutum, IV, 63.
 Phyllostoma hastatum, I, 166.
 Physeter macrocephalus, II, 144.
 Pica pica hudsonica, II, 320.
 Pici, Order, III, 11.
 Pickerel, Chain, IV, 216.
 Picus pubescens medianus, III, 18.
 Pigeon, Banded-Tailed, III, 89.
 " Passenger, III, 84.
 Pigeons and Doves, Order of, III, 84.
 Pika Family, I, 181, 261.
 Pike, IV, 214.
 " Wall-Eyed, IV, 192.
 Pike, Mr. Warburton, II, 102.
 Pike-Perch, Yellow, IV, 192.
 Piltown Skull, I, 21.
 Pine-Hen, III, 109.
 Pinniped, Grouse, III, 111.
 Pinnipedia, Order, I, 4, 112, 114.
 Pipa americana, IV, 140.
 Pipefishes, Order of, IV, 286.
 Piranga erythromelas, II, 298.

- Pithecia satanas*, I, 34.
Pityophis melanoleucus, IV, 87.
 Platypus, or Duck-Bill, II, 196.
Plautus impennis, III, 283.
Plegadis autumnalis, III, 161.
Plethodon glutinosus, IV, 147.
 Plover, American Golden, III, 131.
 " Green, III, 131.
 " Kill-Deer, III, 130.
 Pocket Gopher Family, I, 245.
Podilymbus podiceps, III, 260.
Polyodon spathula, IV, 303.
Pomatomus saltatrix, IV, 193.
Pomoxis annularis, IV, 184.
 " *sparoides*, IV, 180.
 Pompano, Common, IV, 203.
 Poor Will, III, 6.
 Porcupine, Canada, I, 252.
 " Family, I, 181, 252.
 " Prehensile-Tailed, I, 252.
 " Yellow-Haired, I, 253.
 Porpoise, Common, II, 154.
 " Sperm Whale, II, 145.
 Porpoises and Whales, Order of, II, 138.
Porzana carolina, III, 144.
 Prairie-Chicken, III, 112.
 Prairie-"Dog," I, 201.
 " and Burrowing Owl, III, 51.
 " Burrow, I, 205.
 " Hunter, I, 71.
 " pamphlet on the, I, 270.
 Prairie Wolf, I, 56.
 Pribilof Islands, I, 123.
 Primates, I, 4, 9.
Pristis pectinatus, IV, 315.
 Proboscidea, I, 4.
Procellaria glacialis, III, 273.
 " *pelagica*, III, 239.
Procyon lotor, I, 109.
 Procyonidae, I, 40, 109.
Progne subis, II, 293.
Promops californicus, I, 167, 169.
 Protean, subterranean, IV, 154.
 Protection of Birds, II, 244.
 " of Mammals, II, 199.
Proteus anguineus, IV, 153.
 Protopterus, IV, 176.
Pseudemys rubriventris, IV, 34.
Pseudopleuronectes americanus, IV, 274.
 Psittaci, Order, III, 28.
 Ptarmigan, III, 120.
 " White-Tailed, III, 123.
 " Willow, III, 123.
Pteropus edwardsi, I, 177.
 Puffin, Common, or "Sea Parrot," III, 270.
 " Tufted, III, 270.
 Puma, I, 44.
Putorius erminea, I, 73.
 " *nigripes*, I, 71.
 " *rixosus*, I, 72.
 Pygopodes, Order, III, 167, 259.
Python molurus, IV, 81.
 " *reticulatus*, IV, 79.
 Quail, III, 97.
 " Bob-White, III, 98.
 " California Mountain, III, 104.
 " Common, III, 98.
 " Mearns, III, 105.
 " Valley, III, 104.
Querquedula cyanoptera, III, 176.
 " *discors*, III, 176.
Quiscalus quiscula, II, 318.
 Rabbit, Gray, I, 267.
 " Jack, I, 267, 269.
 Rabbit and Hare Family, I, 262.
 Raccoon Family, I, 40, 109.
 Racer, Blue, IV, 88.
 " Green, IV, 88.
 " Red, IV, 90.
Rachianectes glaucus, II, 144.
 Raiae, IV, 314.
 Rail Family, III, 143.
 " Sora, III, 144.
 " Virginia, III, 143.
 Rain-Crow, III, 22.
 Rainey, Paul J., II, 24.
Rallus virginianus, III, 143.
Rana catesbiana, IV, 135.
 " *clamata*, IV, 134.
 " *sylvatica*, IV, 136.
 " *virescens*, IV, 133.
Rangifer arcticus, II, 97, 99.
 " *caribou*, II, 90.
 " *granti*, II, 99.
 " *groenlandicus*, II, 96.
 " *osborni*, II, 94.
 " *pearyi*, II, 94.
 " *stonei*, II, 95.

- Raptores, Order, III, 34.
 Rat, Cotton, or Marsh, I, 233.
 " Coypu, I, 244, 250.
 " Domestic, I, 245.
 " Kangaroo, I, 180, 241, 245.
 " Pack, or Trading, I, 230, 245.
 " Tree, I, 249.
 " Wood, I, 222, 232.
 Rat and Mouse Family, I, 180.
 Ratitae, Order, III, 276.
 Rats and Rat-like Animals, I, 222, 244.
 Rattlesnake, IV, 100.
 " Diamond, IV, 103.
 " Dog-Faced, IV, 100.
 " Edwards', IV, 100.
 " Green, IV, 100.
 " Ground, IV, 100.
 " Horned, IV, 106.
 " Massasauga, IV, 100.
 " Pacific, IV, 100.
 " Prairie, IV, 100, 102.
 " Texas, IV, 103.
 " Timber, or Banded, IV, 104.
 " White, IV, 100.
 Raven, American, II, 329.
 Ray, Beaked, IV, 314.
 " Devil-Fish, IV, 318.
 " Shark-, IV, 314.
 " Sting, IV, 317.
 Red Horse, IV, 260.
 Redstart, American, II, 285.
 Reed Bird, II, 311.
 Regulus calendula, II, 268.
 Reindeer, in Alaska, II, 105.
 Reithrodontomys leontii, I, 233.
 Remora, IV, 212.
 Reptile House, IV, 71.
 Reptiles, Food Consumed by, IV, 71.
 " Introduction to the Class of, IV, 3.
 " Orders of, IV, 6.
 " Poisonous Species of, IV, 8.
 "Reptiles of the World," IV, 80.
 Rhamphobatis ancylostomus, IV, 314.
 Rhea americana, III, 277.
 Rhinobatis lentiginosus, IV, 314.
 Rhinodon typicus, IV, 313.
 Rhytina gigas, II, 159, 164.
 Rice Bird, II, 311.
 Ring-Tail Monkey, I, 11, 30.
 Road-Runner, III, 24.
 Robin, II, 260.
 Roccus lineatus, IV, 188.
 Rockfish, IV, 188.
 Rodentia, I, 4, 180.
 Roosevelt, Theodore, I, 47; III, 248.
 Rule for calculating weight, II, 70.
 Rungius, Carl, II, 119.
 Rutter, Cloudsley, IV, 231.
 Rynchops nigra, III, 256.
 Sage-Grouse, III, 117.
 Saimiri sciurea, I, 33.
 Saki, Black, I, 34.
 Salamander, Free-Gilled, IV, 153.
 " Giant, IV, 151.
 " Siren, or Mud-"Eel," IV, 155.
 Salamanders, Eel-like, IV, 152.
 " Family of, IV, 143.
 " Spotted, IV, 144, 147.
 " Two-Legged, IV, 155.
 Salmo clarkii, IV, 220.
 " gairdneri, IV, 223.
 " irideus, IV, 221.
 " ouananiche, IV, 242.
 " salar, IV, 239.
 " sebago, IV, 243.
 Salmon, Atlantic, IV, 239.
 " Blueback, or Sockeye, IV, 236.
 " destruction of, IV, 233.
 " Dog, IV, 238.
 " Family of the, IV, 228.
 " Groups of American, IV, 229.
 " Humpback, IV, 238.
 " Ouananiche, IV, 242.
 " Quinnet, IV, 235.
 " Sebago, IV, 243.
 " Silver, IV, 237.
 Salmon and Trout, Order of, IV, 218.
 Salvelinus fontinalis, IV, 226.
 Sand-Piper, Least, III, 134.
 " Semi-Palmated, III, 134.
 Sapajou, White-Throated, I, 11, 30.
 Sapsucker, Yellow-Bellied, III, 20.
 Sarcorhampus gryphus, III, 83.
 Sawfish, IV, 315.
 Scalops aquaticus, I, 151.
 Scammon, Capt. C. M., II, 140, 148.
 Scaphiopus holbrooki, IV, 140.
 Sciuridae, I, 180.
 Sciuropterus volans, I, 210.
 Sciurus carolinensis, I, 184.
 " douglasi, I, 188.

- Sciurus erythrogaster*, I, 189.
 " *fremonti*, I, 189.
 " *griseus*, I, 186.
 " *hudsonicus*, I, 187.
 " *ludovicianus*, I, 187.
 " *malabaricus*, I, 189.
 " *niger*, I, 186.
 " *prevosti*, I, 190.
Scomberomorus maculatus, IV, 195.
Scoter, American, III, 173.
 " Surf, III, 173.
 " White-Winged, III, 195.
Scotiaptex nebulosa, III, 42.
Sea-Bass, Black, IV, 186.
 " Family of the, IV, 186.
Sea-Cow, *Rhytina*, or Arctic, II, 164.
Sea-Cows, Order of, II, 158.
Sea-Horse, IV, 239.
Sea-Lions, California, I, 115.
 " *Steller*, I, 120.
 "Sea-Parrot" (puffin), III, 270.
 "Sea-Swallow" (tern), III, 254.
Seal, Bearded, I, 137.
 " Family, I, 137.
 " Fur, I, 123-136.
 " Greenland, I, 138.
 " Harbor, I, 137.
 " Harp, I, 137.
 " Hooded, I, 138.
 " Ribbon, or Harlequin, I, 138.
 " Ringed, I, 137.
 " Saddle-Back, I, 138.
Seals and Sea-Lions, Order of, I, 112, 114.
Seiurus motacilla, II, 286.
 " *novaboracensis*, II, 286.
Selous, Percy, killed by moccasin, IV, 113.
Serpents, Order of, IV, 67.
Serum, Anti-venomous, IV, 120.
Seton, Ernest T., III, 106.
Setophaga ruticilla, II, 285.
Sewellel, I, 180, 212.
Shad, Common, IV, 247.
Shark, Basking, IV, 313.
 " Blue, IV, 313.
 " Bone, IV, 313.
 " Great Tiger, IV, 313.
 " Hammer-Head, IV, 313.
 " Mackerel, IV, 313.
 " Man-Eater, or White, IV, 313.
 " Thresher, IV, 313.
 " Tiger, IV, 311, 312.
Shark-Ray, IV, 314.
Sharks, Order of, IV, 308.
Sharp-Tailed Grouse, III, 117.
Shearwaters, III, 239.
Sheep, Argali, II, 38.
 " Big-Horn, II, 25, 28, 209.
 " Black, II, 34.
 " Fannin's, II, 37.
 " Karelin, II, 38.
 " Mexican, II, 32.
 " Nelson's or California, II, 32.
 " Polo's, II, 38.
 " Siar, II, 38.
 " White, II, 32.
Sheep and Cattle Family, II, 4.
Shields, G. O. I, 98; III, 291.
Shore-Birds, Order of, III, 127.
Show't'l, I, 212.
Shrew, Common, I, 154.
 " Family, I, 154.
 " Short-Tailed, I, 155.
Shrikes, II, 288.
Sialia sialis, II, 265.
Siamang, I, 25.
Side-Winder Rattlesnake, IV, 106.
Sigmodon hispidus, I, 233.
Simia satyrus, I, 10, 17.
Simorhynchus pusillus, III, 271.
Siren lacertina, IV, 155.
Sirenia, Order, I, 4; II, 158.
Sirens, Family of, IV, 155.
Sistrurus catenatus, IV, 109.
 " *edwardsi*, IV, 100.
 " *miliarius*, IV, 100.
Sitta carolinensis, II, 270.
Skeleton of American Bison, II, 6.
 " of Bald Eagle, III, 35.
 " of Gorilla, I, 12.
Skimmer, Black, III, 256.
Skink, IV, 58.
Skuas and Jaegers, III, 257.
Skunk, Badger, I, 81.
 " Common, I, 77.
 " Farming, I, 78.
 " Little Spotted, I, 78.
Slaughter for millinery, III, 302.
 " of birds, III, 281.
 " of wild life, III, 300-302.
 "Slider" Terrapin, IV, 34.
Sloth, Three-Toed, II, 177.
 " Two-Toed, II, 178.

- Smith, Hugh M., IV, 169, 299.
- Snake, Black, IV, 88.
- “ Blue, or Green Racer, IV, 88.
- “ Boyle's, IV, 85.
- “ Coach, Whip or Red Racer, IV, 90.
- “ Copperhead, IV, 110.
- “ Corn, Red Racer or Rat, IV, 85.
- “ Fer-de-Lance, or Lance-Head, IV, 115.
- “ Garter, IV, 90.
- “ Gopher, Black, or Indigo, IV, 86.
- “ Harlequin, IV, 114.
- “ Hog-Nosed, IV, 93.
- “ “Hoop,” IV, 73.
- “ King, Chain or Thunder, IV, 83.
- “ Massasauga, IV, 100, 109.
- “ Pine, IV, 87.
- “ Poisons, IV, 116.
- “ Rat, IV, 86.
- “ Rattle-, IV, 100.
- “ Red-Bellied Water, IV, 91.
- “ Sonoran Coral, IV, 115.
- “ Water, IV, 92.
- “ Water-Moccasin, IV, 110.
- “Snake,” Glass, IV, 65.
- Snake-Bird, III, 225.
- Snake-bites, Treatment of, IV, 116.
- Snakes, captive, Food of, IV, 71.
- “ Harmless, of the United States, IV, 83.
- “ Oviparous, IV, 70.
- “ Poisonous, of North America, IV, 94.
- “ Viviparous, IV, 70.
- Snapper, Red, IV, 206.
- Snipe, Wilson's, or Jack, III, 133.
- Snow Bird, II, 302.
- Snow Bunting, II, 301.
- Snyder, Keeper Chas. E., IV, 82, 131.
- Somateria dresseri, III, 193.
- “ spectabilis, III, 201.
- Sorex personatus, I, 154.
- Sparrow, English, II, 305.
- “ Song, II, 303.
- “ Tree, II, 303.
- “ White-Throated, II, 304.
- Spatula clypeata, III, 177.
- Speotito cucularia hypogæa, III, 50.
- Spermophile, or Ground Squirrel, I, 195.
- “ Franklin's, I, 198.
- “ Richardson's, I, 200.
- “ Say's, I, 194.
- Spermophile, Thirteen-Lined, or Leopard, I, 197.
- Sphargis coriacea, IV, 51.
- Spheniscus demersus, III, 274.
- Sphyrapicus varius, III, 20.
- Sphyrna zygaena, IV, 313.
- Spilogale, I, 78.
- Spilotes corais couperii, IV, 86.
- Spizella monticola, II, 303.
- Spoonbill Family, III, 161.
- “ Roseate, III, 161.
- Squali, IV, 308.
- Squirrel, Antelope, I, 194.
- “ California Gray, I, 186.
- “ Douglas, I, 188.
- “ Family, I, 180, 181.
- “ Fremont's, I, 189.
- “ Gray, I, 184.
- “ Malabar, I, 189.
- “ Northern Fox, or Cat, I, 187.
- “ Prevost's, I, 190.
- “ Red, or Chickaree, I, 187.
- “ Southern Fox, I, 186.
- Squirrels, Flying, I, 210.
- “ Fox, I, 186.
- “ Ground, I, 195, 270.
- “ Rock, or Chipmunks, I, 190.
- “ Tree, I, 183.
- Stake-Driver (bittern), III, 158.
- Starling, II, 312.
- Steganopodes, Order, II, 255; III, 167, 213.
- Stegastoma tigrinum, IV, 311.
- Stejneger, Dr. Leonhard, IV, 118.
- Stercorarius parasiticus, III, 257.
- Stereolepis gigas, IV, 186.
- Sterna hirundo, III, 254.
- Stickleback, Two-Spined, IV, 265.
- Sting Ray, or “Stingaree,” IV, 317.
- Stizostedion vitreum, IV, 192.
- Stork Family, III, 159.
- Strigidae, Family, III, 34.
- Strix pratincola, III, 37.
- Struthio camelus, III, 276.
- Sturgeon, Common, IV, 298.
- “ Industry, extinction of, IV, 299.
- “ Lake, IV, 298.
- “ Short-Nosed, IV, 298.
- “ Shovel-Nosed, IV, 303.
- “ White, IV, 298.
- Sturnella magna, II, 314.
- “ neglecta, II, 316.

- Sturnus Vulgaris*, II, 312.
 Sucker, Common Brook, or White, IV, 258.
 " Red-Horse, IV, 260.
 Suckers, Carp, and Minnows, Order of, IV, 257.
 Sucking-Fish, IV, 212.
Sula bassana, III, 228.
 Sun-Fish, Black-Gill, or Blue-Gill, IV, 185.
 " Common, IV, 185.
 Swallow Family, II, 293.
 Swallows, II, 297-298.
 " Barn, II, 298.
 " Chimney, III, 6.
 " Cliff, II, 297.
 " Eave, II, 297.
 Swan, Trumpeter, III, 207.
 " Whistling, III, 212.
 Swans, Ducks, and Geese, Order of, III, 167.
 Swift Family, III, 6.
 Swifts, Chimney, III, 6.
 Swimmers, Diving, III, 167.
 " Flying, III, 167.
 " Long-Winged, III, 167, 249.
 " Order of Tube-Nosed, III, 167, 233.
 Swimming-Birds, Orders of, IV, 167.
 Swordfish, IV, 209.
 Sylviidae, Family, II, 266.
Symphalangus syndactylus, I, 25.
Synaptomys cooperi, I, 226.
Syngnathus acus, IV, 286.
Syrnium varium, III, 40.

Tamandua tetradactyla, II, 175.
Tamias striatus, I, 191.
 Tanager, Scarlet, II, 298.
Tantalus loculator, III, 159.
 Tapir Family, II, 4, 124.
Tapirus dowi, II, 124.
 " *terrestris*, II, 124.
 Tarpon, IV, 244.
 " *atlanticus*, IV, 244.
 Tarpon, "Book of the, IV, 247.
 Tarsier, I, 11.
Tatu novemcinctum, II, 170.
Tayassu albirostre, II, 123.
 " *tajacu*, II, 121.
 Teal, Blue-Winged, III, 176.
 " Cinnamon, III, 176.
 " Green-Winged, III, 172.

 Teetee, I, 33.
 Tern, Common, III, 254.
 Terrapin, Alligator, IV, 39.
 " Diamond-Back, IV, 36.
 " Ellachick, IV, 36.
 " Matamata, IV, 41.
 " Painted, IV, 35.
 " Pine-Barren, IV, 32.
 " Pond, IV, 35.
 " Red-Bellied, or "Slider," IV, 34.
 " Snapping, IV, 40.
 Terrapins, Fresh-Water, IV, 28.
 " Smooth-Shelled, IV, 28, 34.
Testudo polyphemus, IV, 30.
 " *vicina*, IV, 28.
 Tetraonidae, III, 98.
Thalarchos maritimus, I, 87.
Thalassochelys caretta, IV, 47.
Theropithecus gelada, I, 10, 29.
 Thrasher, Brown, II, 275.
 Thrushes, Water, II, 286.
 " Wood, II, 264.
 Thrushes, II, 260.
 Thunder-Pumper (bittern), III, 158.
Thunnus thynnus, IV, 197.
 Tiger-Cat, I, 48, 51.
 Titmouse, Black-Capped, II, 269.
 Toad, Common, IV, 138.
 " Horned, IV, 63.
 " Spade-Foot, IV, 140.
 " Surinam, IV, 140.
 Toads and Frogs, Order of, IV, 129.
Toxopeutes sexcinctus, II, 167.
Tomistoma schlegeli, IV, 10.
 Tortoise, Box, IV, 31.
 " Giant, IV, 28.
 " Gopher, IV, 30.
 " Pond, IV, 35.
 Tortoises and Turtles, Order of, IV, 25, 27.
 Townsend, Chas. C., III, 191.
 " Chas. H., II, 104, 105.
Trachinotus carolinus, IV, 203.
 " *goodei*, IV, 203.
 Tree Frogs, Family of, IV, 136.
 Tree-Creepers, II, 272.
Trichechus americanus, II, 159.
 " *latirostris*, II, 159.
 " *senegalensis*, II, 159.
 Trigger-Fish, IV, 254.
Triton torosus, IV, 149.
 " *viridescens*, IV, 149.

- Trochilus colubris*, III, 8.
Troglodytes aedon, II, 274.
 Trout, Brook, or Speckled, IV, 226.
 " Lake, or Mackinaw, IV, 224.
 " Mountain, or Black-Spotted, IV, 220.
 " Rainbow, IV, 221.
 " Steelhead, or Salmon, IV, 223.
 Trout and Salmon, Order of, IV, 218.
Trygon sabina, IV, 317.
Tubinares, Order, III, 167, 233.
 Tuna, or Tunny, IV, 197.
 " Club, IV, 201, 211.
 Turkey, Ocellated, III, 126.
 " Wild, III, 125.
 Turtle, Green, IV, 45.
 " Hard-Shelled Sea, IV, 45.
 " Harp, or Lyre, IV, 51.
 " Hawksbill or Tortoise-Shell, IV, 46.
 " Leather-Backed, IV, 51.
 " Leathery-Shelled Sea, IV, 51.
 " Loggerhead, IV, 47.
 " Mud, IV, 32.
 " Musk, or Stink-Pot, IV, 33.
 " Snapping, IV, 40.
 " Soft-Shelled, IV, 42.
 " Wood, IV, 37.
Tympanuchus americanus, III, 111.
 " *cupido*, III, 115.
Typhlomolge rathbuni, IV, 154.
Typtonectes compressicauda, IV, 124.
Tyrannus tyrannus, II, 331.
 Tyrrell, J. B., II, 95, 101, 102.

Uakaria calva, I, 34.
 Ungulata, Order, II, 3.
 Upland Game Birds, III, 96.
Uria lomvia, III, 266.
 " *troile*, III, 266.
 " " *californica*, III, 266.
Urocyon californicus, I, 59.
 " *cinereoargenteus*, I, 66.
 " *floridanus*, I, 59.
 " *scottii*, I, 59.
 " *texensis*, I, 59.
 " *townsendi*, I, 59.
 Urodela, Order, IV, 124, 142.
 Ursidae, I, 40, 82.
Ursus americanus, I, 85, 87, 101.
 " " *sornborgeri*, I, 87.
 " *carlottae*, I, 87.
 " *dalli*, I, 87, 93.

Ursus dalli gyas, I, 87.
 " *emmonsii*, I, 87, 102.
 " *eulophus*, I, 87.
 " *horribilis*, I, 87, 93.
 " " *alascensis*, I, 87.
 " " *horriaeus*, I, 87.
 " *kermodei*, I, 87, 105, 107.
 " *luteolus*, I, 87.
 " *merriami*, I, 87.
 " *middendorffi*, I, 87, 91.
 " *richardsoni*, I, 87.
 " *sitkensis*, I, 87.

Vampyrus spectrum, I, 168.
 Vanishing Wild Life," "Our (book), II, 87;
 III, 78, 303.
 Vertebrates, Lowest Classes of, IV, 321.
Vespertilionidae, I, 163.
 "Viper," Blowing, IV, 93.
Vireo olivaceus, II, 287.
 " *noveboracensis*, II, 287.
Vireos, II, 287.
Viscacha, I, 254, 256.
Viscacia viscacia, I, 256.
 Vole, I, 229.
 " Northwestern, I, 230.
Vulpes deletrix, I, 58.
 " *fulvus*, I, 59.
 " " *argentatus*, I, 58.
 " " *decussatus*, I, 58.
 " *hallengensis*, I, 58.
 " *harrimani*, I, 58.
 " *lagopus*, I, 63.
 " *macrotis*, I, 58.
 " *macrourus*, I, 58.
 " *velox*, I, 63.
 Vulture, Black, III, 75.
 " California, III, 76.
 " Common Turkey, III, 74.
 Vultures, Family of, III, 74.

 Wallabies, II, 187-189.
 Wallihan, A. G., II, 73.
 Walrus, I, 114, 141.
 " Atlantic, I, 146.
 " Pacific, I, 141.
 Wapiti, II, 3, 55, 66, 218.
 Warbler, Yellow, II, 283.
 Warblers, II, 280.
 Ward, Henry A., II, 166.
 Water-Frogs, Family of, IV, 134.

- Waxwings, II, 290.
 Weasel, Common, I, 72.
 " Least, I, 72.
 Webb, A. C., II, 285.
 Webster, Frederic S., IV, 296.
 Whale, Bowhead, Greenland or Polar, II, 142.
 " California Gray, II, 144.
 " Pygmy Sperm, II, 145.
 " Sulphur-Bottom, II, 140.
 " White, II, 146.
 Whales, Family of Baleen, II, 140.
 " Family of Sperm, II, 144.
 " various species, II, 144.
 Whales and Porpoises, Order of, II, 138.
 Wharton, W. P., II, 13.
 Whippoorwill, III, 5.
 Whiskey-Jack, II, 327.
 Whitefish, Common, IV, 250.
 Wichita National Bison Range, II, 13.
 Widgeon, III, 172.
 Wilderness Areas in N. A., II, 201.
 Williams, A. Bryan, II, 234.
 Willson, Minnie Moore, III, 30.
 Wind Cave National Bison Range, II, 13.
 Wingless Land Birds, Order of, III, 276.
 Wolcott, F. C., I, 95.
 Wolf, Gray or Timber, I, 54.
 " Prairie, I, 56.
 Wolverine, I, 74.
 Woodchuck, I, 208.
 Woodcock, American, III, 132.
 Woodpecker, Ant-Eating, III, 18.
 " Downy, III, 18.
 " Golden-Winged, III, 14.
 " Hairy, III, 19.
 " Red-Headed, III, 15.
 Woodpeckers, Order of, III, 11.
 Wrens, II, 274.
 Wright, Mrs. Mabel Osgood, II, 284, 310.
 Wyoming, II, 220.
 Xanthocephalus xanthocephalus, II, 314.
 Xiphias gladius, IV, 209.
 Yellow-Bird, Summer, II, 283.
 Yellowstone Park Bison, II, 13.
 Zalophus californianus, I, 115.
 Zamelodia ludoviciana, II, 308.
 Zamenis constrictor, IV, 88.
 " flagellum, IV, 90.
 " " frenatum, IV, 90.
 Zapodidae, I, 222.
 Zapus hudsonius, I, 243.
 Zenaidura macroura, III, 91.
 Zonotrichia albicollis, II, 304.
 Zoological Park, New York, I, 15, 83, 89, 93,
 145, 215, 216, 220; II, 8, 23, 24.
 Zoological Society, New York, I, 14; II, 8,
 12.

