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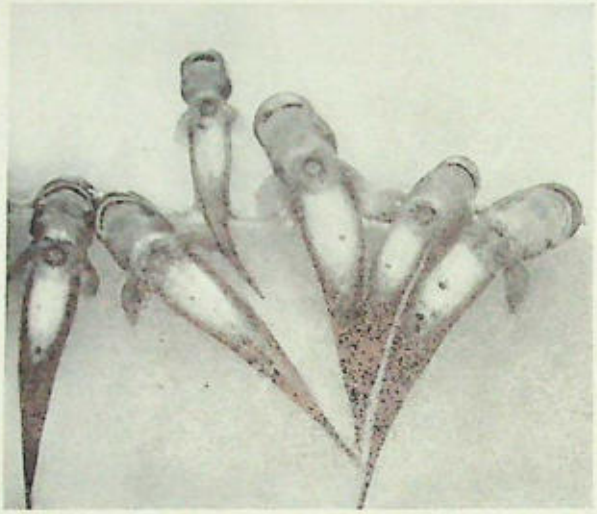

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KING PENGUIN ..... *Cover*

ZOOLOGICAL SOCIETY BULLETIN
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Some strands of Sargassum weed and their inhabitants—five fish, three crabs, a shrimp and a mollusk. For key see page 45. The blue is exactly the color of the Sargasso Sea.
From a drawing in color by Helen Tee-Van.

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ZOOLOGICAL SOCIETY BULLETIN

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VOLUME XXIX MARCH-APRIL, 1926 NUMBER 2

"THE ARCTURUS ADVENTURE"*

Excerpts of Several Chapters from the Story of the Arcturus Oceanographic Expedition

By WILLIAM BEEBE *and* RUTH ROSE

Illustrations from photographs made by William Beebe, John Tee-Van and Ernest B. Schoedsack.

IF HEAT is the mother of all life, then water is surely its father. We came from the water, we are still absolutely dependent upon it, two thirds of our entire body is nothing but water. The mark of the sea is upon us though our home may be the heart of a continent.

The simplest of beings are inhabitants of water—mere droplets of movement, hesitant on the threshold of life, as yet neither quite plants nor animals. A suspended cobweb vivifying the air about it into complex activities would be no more of a marvel than the jellyfish which moves through the sea and is itself the very essence of water. Dry it, and there remain neither bone nor tendons, disturbed organs nor traces of blood, but only the faintest of glistening films, which disintegrates and blows away with the first breath of air. Yet imbued with its ninety and nine parts of salt water, it moves and contracts and throws its poisoned darts, it swallows and digests, and dimly sees and feels, it produces eggs and strews them like chaff as it slowly vibrates on its course. Yet so evanescent is it that it seems like some organic mirage.

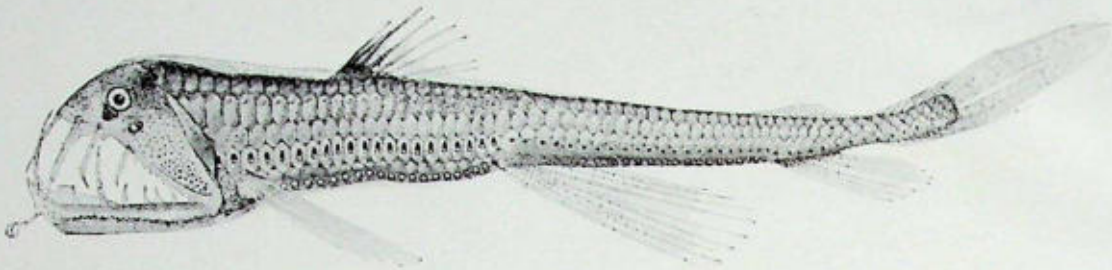
Important as water is to all higher creatures, its actual astounding percentage in tissues and organs is more and more completely concealed from view. Creeping upon the mud and coral are myriads of shellfish whose flesh would tempt every passing fish. By some strange, secret alchemy they draw from the transparent water the hardest and most durable of walls, and encase themselves in shells of lime, of marvellous architecture and splendor of pattern and pigment.

In the course of past time, fishes of the sea covered themselves with scales of shining silver and developed four important fins—prophecies of wonderful legs and arms and feet and hands, if one could only have known. Fishes leaped from the waves and even learned to skim through the air on outstretched fins. And when other creatures insisted on clambering out on mud banks and flipping themselves along, the great breakers merely chased them and good-naturedly rolled and tumbled them back again into the green frothy water.

By the time the first little monkey climbed down a swaying vine for his evening's drink, the dominion of the sea had become lost in the past. The earth was galloped over and burrowed into by myriads of beings; trees were perched on and bored through; the air hummed and whistled with wings and webs and leaping forms. So completely a thing of the past had the sea life become that many creatures had gone back to it as to quite a new element. Their old, old aquatic memories helped them not at all, and the penguins had to restiffen their feathers into scales, and to encase their wings in immobile mittens cut after the fashion of sharks' fins. And the seals ceased the running about upon the land and become completely readapted to a sea life.

So let us return, at least mentally, to the Sea, for there is no happening on land which cannot there be duplicated and often bettered. But to appreciate these similarities to the full, one must become amphibious. As well live in Kansas or Switzerland and know the ocean only in the encyclopedia volume NUN to ODE,

* Published by G. P. Putnam's Sons under the auspices of the New York Zoological Society.



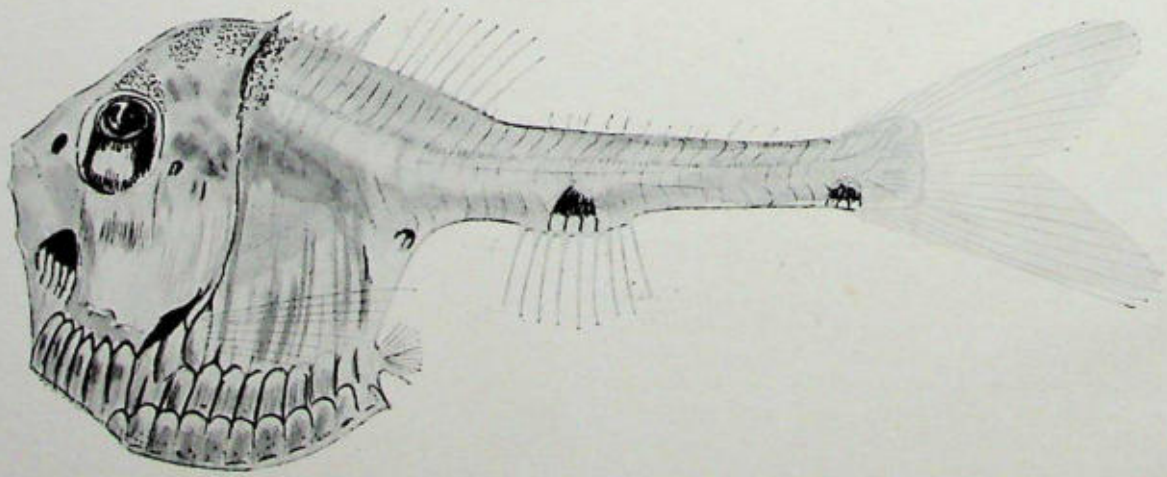
A deep sea fish—*Chauliodus sp.*—from the submerged Hudson Gorge.
From a drawing by Don Dickerman.

as sit in a deck chair and watch it pass or scan its waves with binoculars. To such a watcher no real secret is ever confided.

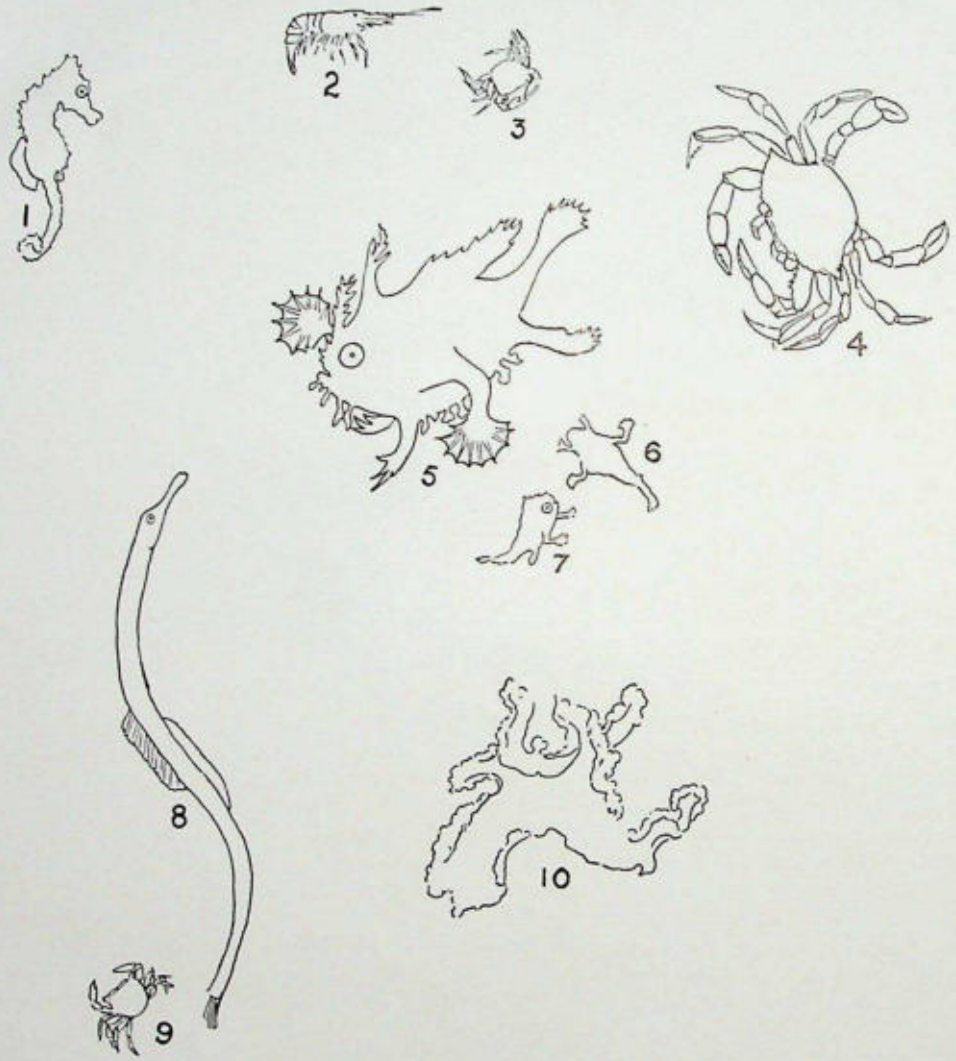
We are grateful to the dry land for standing room, to the air for the breath of life. But any glance askance at the watery depths is but a pitiful or a comic gesture when we remember that 85 per cent. of our brain is water, and much more akin to salt than to fresh. To be sure, we cannot drink salt water and live, but when necessary it is an admirable temporary substitute for blood itself, whereas sweet water would be a fair poison in our veins. Take the man who shudders at the thought of the ocean's depths, and put him in the midst of a tropical desert at breathless noon, or make him climb the Himalayan hills until his very marrow is frosted with the winds which caress Kinchinjunga, and his lungs cry out for their need of oxygen,—and his natal earth will seem quite as inimical as the great waves of mid-ocean or the black liquid depths.

For countless voyages I have hung over the bow of passenger steamers in mid-ocean, straining my eyes downward to watch the living creatures which whirled into sight and swept past. Dolphins, flyingfish, tunny, an occasional shark—these are familiar to all who have ever glanced over the bow. But the rays of the slanting sun striking obliquely into the smooth surface often reveal a myriad, myriad motes—more like aquatic dust than individual organisms, which filled the water from the very surface to as deep as the eye could penetrate.

Toward sunset these would vanish in the increasing dimness, and finally the bow would cut its way through an opaque, oxydized liquid, as unlike water as tar to glass. So the minute sea life becomes, in the dark, redoubly visible, and the ship ploughs a deep furrow through miles of star dust—phosphorescence which will fill the last imaginative human being as full of wonder and awe as it did the first who ever ventured out to sea.



Young Silver Hatchet Fish—*Argyropelecus*—from submerged Hudson Gorge.
From a drawing by Dwight Franklin.



Some inhabitants of Sargassum Weed. A key to the color-plate frontispiece. From a tracing made over the original drawing by Helen Tee-Van.

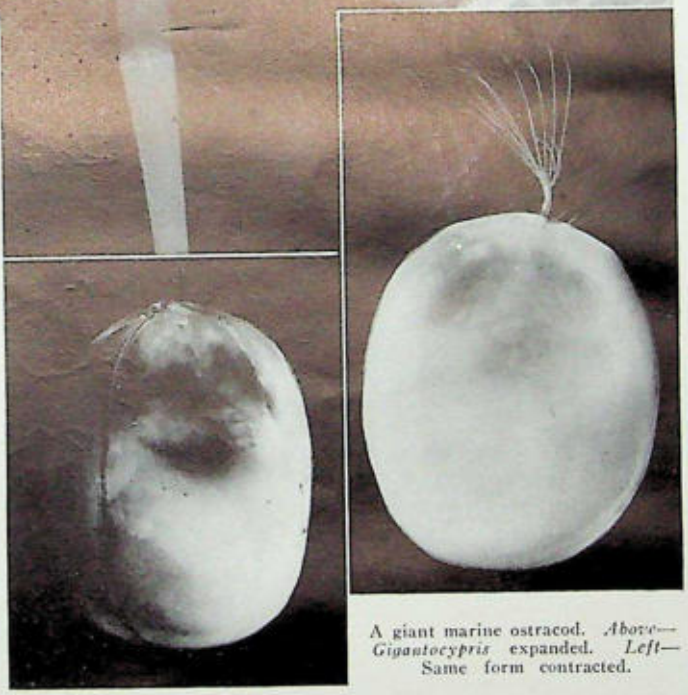
1. Sea-horse, *Hippocampus ramulosus;* 2. Shrimp, *Palaemon tenuicornis;* 3 and 9. Columbus' Crab, *Planes minutus;* 4. Swimming Crab, *Portunus sayi;* 5, 6 and 7. Sargassum Fish, *Pterophryne histrio;* 8. Pipe-fish, *Syngnathus pelagicus;* 10. Naked Mollusk, *Scilloea pelagica.* Many feathery white Hydroids are visible.

The floating oceanic life is known as plankton—indicating the helplessness of these wanderers, drifting about at the direction of the winds and currents. Even vaguely to estimate the abundance or numbers of these powdery clouds of animals of the ocean is to attempt a Herculean task, secondly only to numbering the sands of the shore. One dark, moonless evening I put out a silk surface net, the mouth of which was round, and about a metre or a yard in diameter. At the farther end of the net a quart preserve jar was tied to receive and hold any small creatures which might be caught as the net was drawn slowly along the surface of the water. This was done at the speed of two knots and kept up for the duration of one hour. When drawn in, the net sagged heavily and we poured out an overflowing mass of rich pink jelly into a white flat tray. This I weighed carefully and then took, as exactly as possible, a one-hundred-and-fiftieth portion. I began to go over this but soon became discouraged, and again divided it and set to work on one-sixth of the fraction on which I had first

Making a midnight haul from the boom-walk of the *Arcturus*. Below are two pictures of a gigantic marine ostracod—*Gigantocypris*—contracted and expanded.

started. After many hours of eye-straining and counting under the microscope, I conservatively estimated my 1/150th part of the hour's plankton haul as follows:

Feathery copepods—Candace-like	7,920
Bright blue copepods—Pontella-like	71,400
Other copepods—Calanus-like, pink	139,320
Bivalve crustacea—Ostracod-like	4,920
Short-eyed shrimps	720
Siphonophores	14,400
Heliced snails	8,880
Purple Ianthina snails	13,440
Egg masses of snails	1,080
Free eggs, various	5,280
Arrow-like flying snails	2,520
Nautilus-like flying snails	240
Oyster-like flying snails	960
	271,080

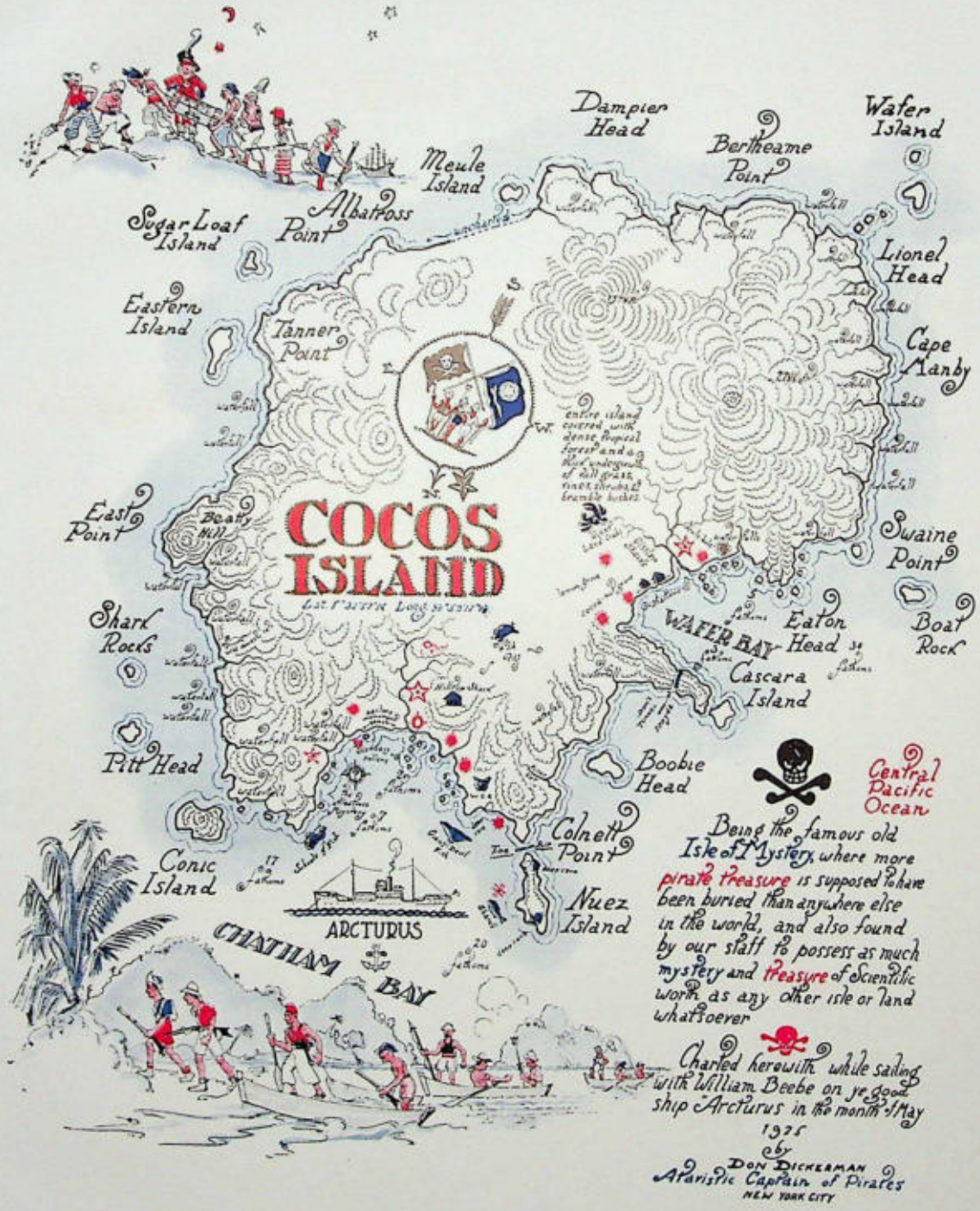


A giant marine ostracod. *Above*—*Gigantocypris* expanded. *Left*—Same form contracted.

If we multiply this by one hundred and fifty we get forty million, six hundred and sixty-two thousand individuals. Please remember that this is a very conservative estimate of only a few of the more easily counted groups in one small haul of an hour's duration, and the magnitude of the life of the sea will begin to dawn upon our minds.

My own interest in plankton is wholly that of trying to disentangle the lives of some of the small people—to put myself in their places by day and night, but I feel that I must establish their importance in the minds of more practical and far-seeing readers. Realize, then, that even for our human race, the universe of plankton is of vital importance. The surface-loving copepods are commonly and correctly known as "whale food" and they are also the most important food of many fishes. Only at the surface can vegetable life exist and develop, changing sunlight into edible materials, and in plankton diatoms and other plants affording satisfactory aquatic fodder to the small grazing animals about them. They thus start the ball of life rolling, which does not cease until it includes the possibility of continued existence for whales and food fishes, while, in the future, the whole human race may come to depend upon this larder of ocean.

When I began scooping up, one by one, the creatures which for years I had watched go past out of reach, I learned to admire and to have a real affection for these little fellow beings who lived their lives with me on this whirling planet.



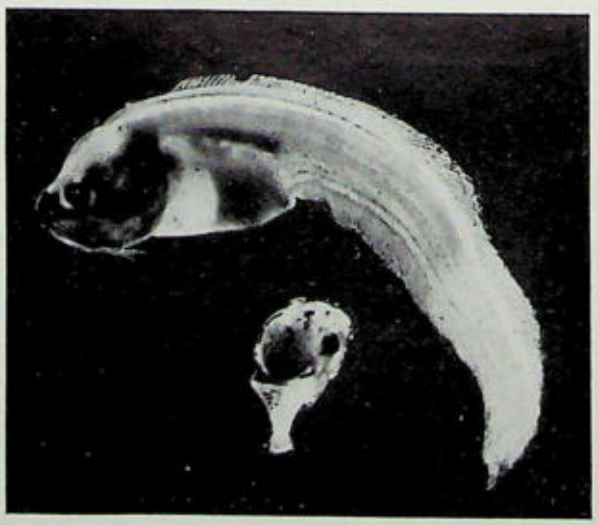
An unscientific map of Cocos Island.
From a drawing in colors made by Don Dickerman.

For the mid-ocean folk there is no rest as we know it. Somehow or other they must keep themselves suspended. A list of possible ways, thinking as always from our own experience, would include swimming or flying, treading water, balloons of air or gas, or clinging to some bit of floating wreckage, whether from a storm-broken ship, a bit of porous lava, or a pinion dropped by a passing sea-bird.

Oblong pieces of whitish scum had tantalized me for many voyages, and even when I had emptied one of these bits from my net into a small aquarium I could make nothing of the mass of bubbles, until I looked beneath the surface and there saw that exquisite violet sea-shell with the euphonious name of *Ianthina fragilis*. Although this snail lives in a home of tissue-thin lime, it yet spends its entire life at the surface of the ocean. Its relations which we know on land and leave a trail of glairy slime wherever they walk, and Ianthina still has the gland which secretes this, but has etherealized its use. The thin secretion is poured forth, and then, by successive upreachings of a part of the foot bubbles of air are caught and entangled in the slime, which soon extends out as a narrow buoyant raft, the shell hanging down at one end. The bubble slime is not only balloon but nursery, and egg after egg is suspended from the lower surface. So abundant was this snail that I observed them with only general interest, thinking, of course, that its whole life history was well known, but on my return I found that this was far from the case, and that few facts are known about it.

An argonaut or paper nautilus. It is really a diminutive octopus with the most exquisite of shells. Formerly it was thought that the nautilus raised its two broad arms and used them as sails.

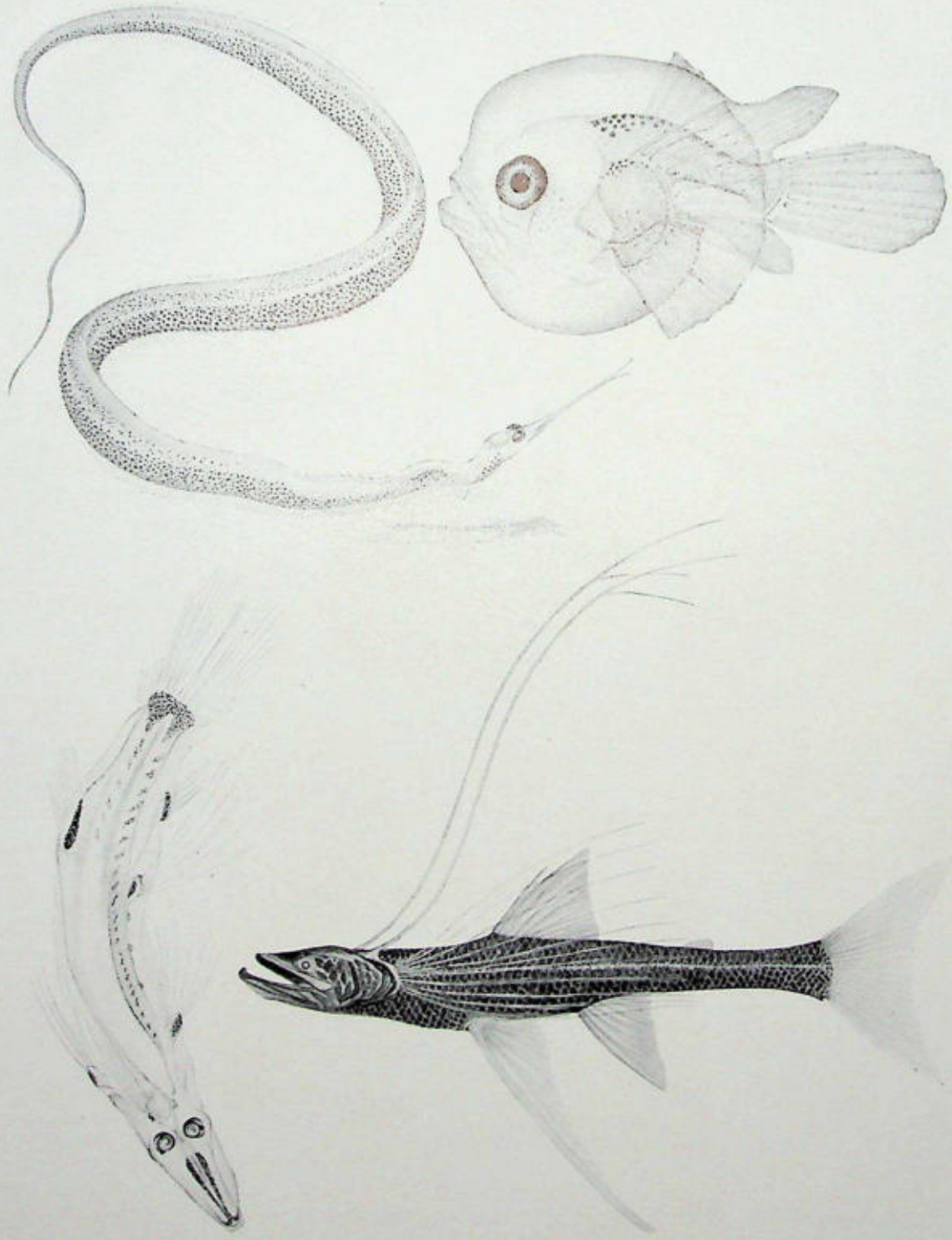
Flotsam of the ocean. Barnacles on a floating cocoanut picked up in mid-Pacific. In some way the life of the sea must keep suspended, either by swimming, flying or clinging to floating wreckage.



A new genus and species of a deep-sea Brotulid fish. One of that vast army below the twilight zone. Only casual observations have been made on the life fishes lead in the darkness of their underwater world.

Night after night small white spots floated about on the water just beyond the glare of the gangway electric lights. In vain we tried to net them. Now and then several would join together in a sinuous row and swim slowly along. At last, with an effort which almost precipitated him into the sea, Serge Chetyrkin scooped one up and dropped it into a small jar. To my astonishment I saw it was an argonaut or nautilus—a paper nautilus — which, in other words, is a diminutive octopus with the most exquisite shell in the world. Never have I seen a creature with a more explosive temper—we named her Mrs. Bang on the spot. Hardly had I changed her to a small aquarium when she angrily shot forth a cloud of sepia, and had to be transferred twice before her ink-bag was emptied and I could observe her clearly.

She rested quietly on the bottom with her many arms wrapped about her beautiful brown and white shell. But as soon as my face approached the glass, she rushed back and forth, shooting directly at me or bumping against the opposite glass, and finally backing into a corner. Here she spitefully squirted spouts of water through her siphon, until I gave her a small fish. She snatched it ungraciously, bit its head off and ate the body, feeling suspiciously about with three or four arms in my di-



Some deep-sea fishes taken on the *Arcturus*. *Upper left*—Snipe-billed Eel. *Upper right*—A surface swimming larval fish. *Lower left*—An unnamed fish with eyes on top of its head. *Lower right*—*Bathypterois*—a blind fish of abyssmal depths.

In the Galapagos Archipelago. Looking toward Gardner from Hood Island. The *Arcturus* anchored in a snug harbor.

rection the while she ate the meal.

Two days later she went into such a paroxysm of rage that she flung herself clear out of her shell. I carefully picked this up and found her eggs still remaining inside. They were even-ended ovals, about ten by fifteen millimetres, with a tiny thread at one end which attached them loosely together, exactly like a minature bunch of grapes—the smaller stems growing out from larger and these in turn from a twisted, central rope. The embryos were in various, well-advanced stages, with the future eyes of the infant argonauts marked by two large, red spots.

The shell of the argonaut is secreted by two great flat plates on the arms, and it was formerly thought that when, in calm weather, the owner rose to the surface, it sat back comfortably in its shell, raised the two broad arms aloft and used them as sails. This performance should properly take place only within sight of the fleets of entangled ships in the Sargasso Sea!

I never tired of watching the squids and octopuses which we captured. Soon after we landed the nautilus, Serge, with his usual skill, caught a two-foot squid which squirted sepia all over us and bit our hands before we could drop it in an aquarium. When it quieted down it pulsated slowly, while the colors came and went over the body in such a way that new adjectives will have to be coined adequately to describe it—reds, blacks, browns, yellows, rolling, surging, springing into vision as the pigment spots contracted or expanded, a living, liquid palette.

The staring eyes were oval, and of an astonishing turquoise blue, and even on this surface, scarlet spots grew and passed—vanishing completely, only to reappear and coalesce so that the turquoise became carnelian. I looked into the sinister, narrow, cat-like pupils, and they seemed to express all the horrible mystery of things which should not be, such as these monstrous, flabby creatures calling the snail, the slug, the nautilus and the oyster brothers—possessing not even the prestige of having fallen, like the humble sea-squirts, from higher aspirations,—shellfish they are and nothing else. And yet unreasonably possessing an eye, as well as or better developed than our own. When to a low evolved mollusk thing, there has been given a "window of the soul" such as this, one wonders what secret, what thing of enormous value must have been bartered for it. A hand even would not have been so unexpected nor a foot patterned after those of infinitely higher beings, but such an eye should not be in such a body.

The lava shores of the Galapagos Archipelago. North shore of Gardner Island. Among the scanty vegetation are two interesting forms of cactus.

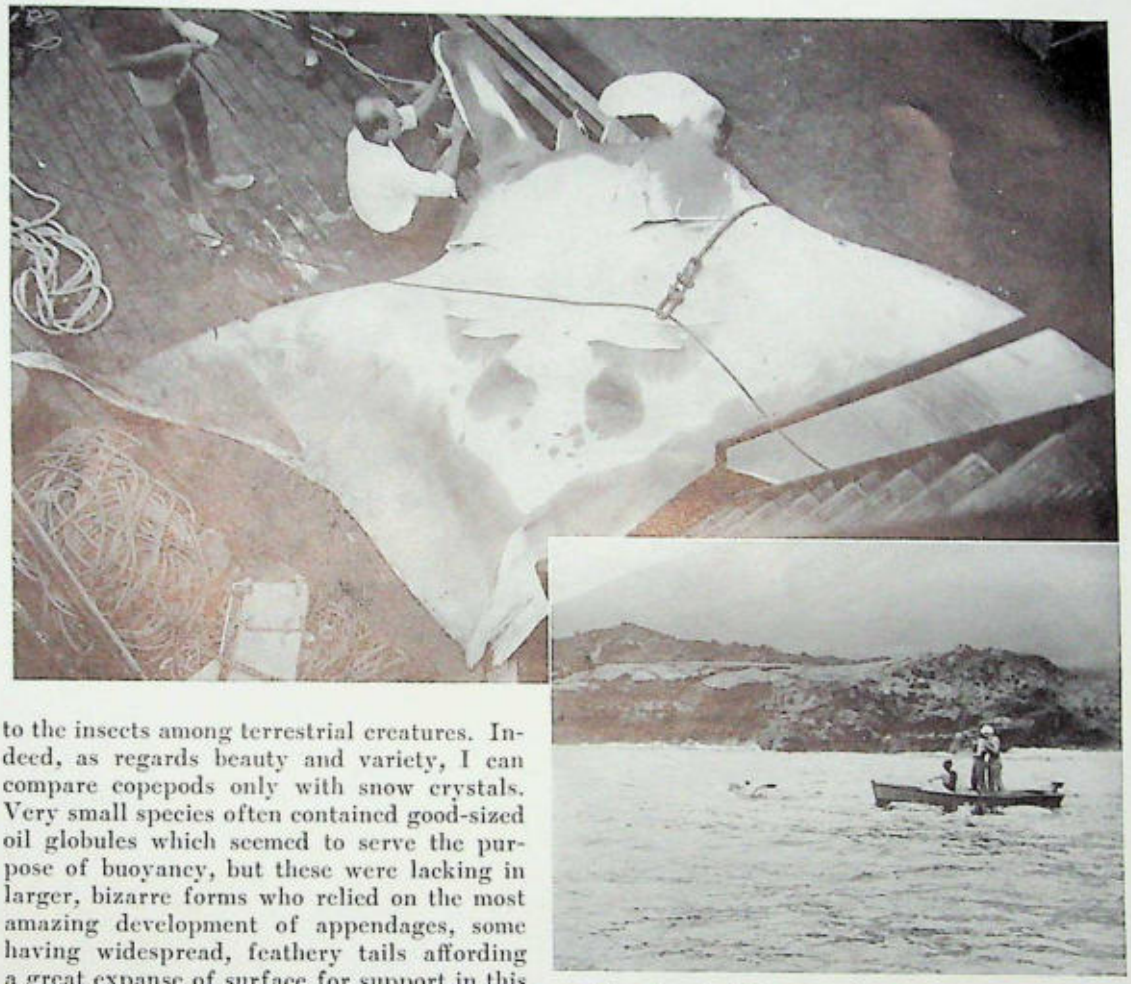
Before we lose ourselves among the small folk of mid-ocean let us strike a contrast. Day after day, from the crow's nest or the bridge, we caught sight of the monsters of the ocean's surface,—occasional sunfish so gigantic that, so long as they remained out of reach of a yard-stick, it were better for a scientist to call them merely exceedingly large. A layman might use the simile of a vertical barn-door and not exceed the truth. But the same time-worn simile if considered horizontally, would be less than the actual fact if applied to some of the devil-fish or giant rays which we saw. Now and then a playful one would leap almost out of the water, or pass close to the bow on its graceful, leisurely aquatic flight.

North of Narborough they were so numerous that three of the staff, Dickerman, Franklin and Cady, made up their minds to capture one. Assembling every weapon, legitimate and otherwise, which the *Arcturus* afforded, they set out in a tiny row-boat and made good. When, later on, we analyzed the fight from the motion pictures, we realized that luck had surely been with us, for if the great fish had slapped its wing tips a little nearer and higher, the rowboat and devilfishers would have been flattened.

When once a harpoon was deeply fastened to the fish, the battle became merely a question of trying to tire it out, and to hope that the injury inflicted by the hail of bullets would antedate the effect of their accumulating weight. These great fish are not especially wary and a few days before when returning from a diving excursion we played with one for an hour, being splashed with its fin-tips as it turned over.

After two hours the devilfish surrendered and was towed to the *Arcturus*. Several lashings were broken before it was at last drawn out of the water and lowered on the deck. Here was a specimen indeed, not to be placed on the stage of the microscope, but studied by walking around, over and almost into, for its gaping mouth was quite four feet wide. From fin tip to fin tip it measured exactly eighteen feet, and little by little as we cut it up we weighed the pieces and found it to total two thousand three hundred and ten pounds. The liver alone weighed as much as a man, and we found a young devilfish about to be born,—a lusty infant weighing twenty-eight pounds and with a fin spread of over three and a half feet. As usual, the fish had many interesting parasites. I took eight sucking fish from its gills and at least thirty more fell off when it left the water.

Oceanic crustaceans in general and copepods in particular correspond in numbers and variety



The giant devilfish when first harpooned. After two hours it surrendered and was towed to the *Arcturus*. When we analyzed the fight from the moving pictures we realized that luck had been with us.

to the insects among terrestrial creatures. Indeed, as regards beauty and variety, I can compare copepods only with snow crystals. Very small species often contained good-sized oil globules which seemed to serve the purpose of buoyancy, but these were lacking in larger, bizarre forms who relied on the most amazing development of appendages, some having widespread, feathery tails affording a great expanse of surface for support in this thin medium.

In the dark a small dish of this plankton would glow like a trayful of diamonds, but in the light no trace of luminescence could be detected.

Traces of Aquarius or Pisces might reasonably be expected in these submarine regions, but hardly of Sagitarius, and yet hardly any pipette of plankton would fail to show numerous little arrows shooting across the field of vision.

I could never quite escape from a decided Alice-in-Wonderland feeling when I looked into a dish of night plankton scooped from the surface. By keenest scrutiny I could perceive only the usual hosts of small fry, when reaching down and lifting out what seemed only an area of clear water, there would materialize before my eyes a *Phyllosoma*. This was a creature that cast no more shadow than the thinnest skim of clear ice. *Phyllosoma*, or leaf person, was the only name I could give them, although glass crab would be more appropriate.

The most faithful attendants of the *Arcturus* were the tunny fish, who kept close to the bow hour after hour, yielding to the occasional dolphins but returning at once when they had gone. Looking down through the ultramarine film I saw a score of these fish metamorphosed to rainbow colors—rich violet bodies with yellow finlets and tails.

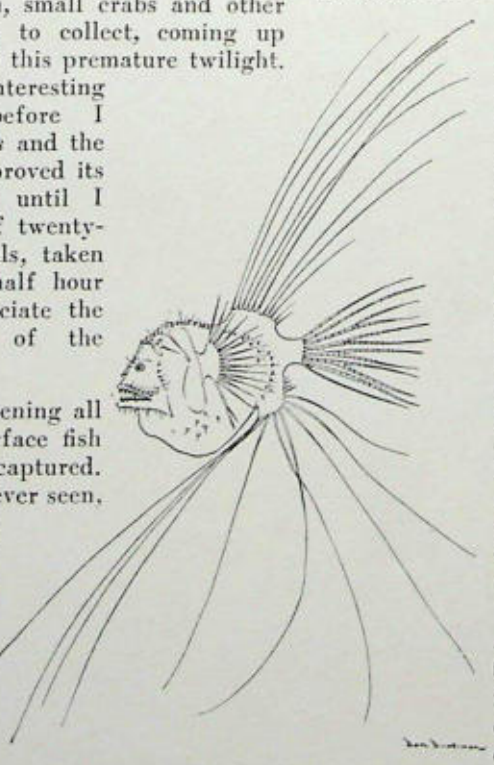
Ten minutes more passed and *Pyrosoma* drifted by—a great, pink, hollow, cylindrical colony of unfortunates who had just missed being vertebrates like the tunny and ourselves. Beneath this cylinder of jelly was a half-dozen pilot-fish. For some reason—and this is the crux of the whole matter—so long as they crowded beneath it, no tunny paid any atten-

tion to them, although far as actual concealment went, they might just as well have been hiding beneath mosquito netting or a Greek peristyle. As our bow approached their living roof they became panic stricken. All six little fish dashed out, and as if moved by the same mechanism, six tunnies gave six snaps in the very foam of the bow wave, and six little pilot-fish were relieved from further worry about their destiny.

I came to have the feeling that far down beyond where my eyes could penetrate were uncounted hosts of little eyes peering upward, waiting for the revealing sunlight to lessen. The cook would throw over an empty tin can, and if it failed to sink there would soon be a small fish of sorts swimming close beneath it. I could imagine the widening cone of shadow which the can cast downward and the fish, feeling its comfortable darkness, following it up until it focussed on the bobbing bit of floating tin.

In calm, sunny weather as the *Arcturus* steamed along at full speed, few or no fish were to be seen in the open water, but when "full stop" would clang and we began to float quietly, on the shady side, fish, small crabs and other creatures would begin to collect, coming up from deeper levels into this premature twilight. I had read of this interesting vertical migration before I started on the *Arcturus* and the contents of every net proved its magnitude. But not until I inaugurated a series of twenty-four hour surface hauls, taken at fifteen minute or half hour intervals, did I appreciate the clock-like regularity of the movement.

Up to 6:30 in the evening all the more abundant surface fish of the daytime were captured. After this, not one was ever seen, but promptly at 7:00 o'clock six species of lantern fish, Myctophids, appeared, and a half hour later their enemies, such as *Astronesthes*, were taken. In early morning the reverse occurred, and only one species of lantern fish ever lingered after 4:30.



Caulophryne—a singular deep-sea fish taken in the submerged Hudson Gorge. From a drawing by Don Dickerman.

In the case of most oceanic organisms we cannot tell by a casual examination whether they are diurnal or nocturnal, but even if we had never seen a living lantern fish, their equipment of lights, like that of fireflies, could mean nothing but a life spent in darkness, and when first I saw among a mass of plankton several of these fish, it was a memorable event.

Several times I rushed to the photographic dark-room with a dead or dying specimen, to see nothing but the gleam from the numerals of my wrist watch. Then one evening I filled a small aquarium with cool sea water and placed in it three newly caught Myctophids. Without a warning one of them flashed out so brilliantly that the glass dish, our hands and our faces were clearly outlined.

I shall consider only the slender-tailed lantern fish (*Myctophum coccoi*) which I took in numbers both in the Atlantic and the Pacific. Imagine a minnow (Colored plates. Bull. Sept., 1925), which is iridescent copper above and silvery white below, not over two inches in length, with large eyes and moderate fins. A full-grown fish weighed a gram, which means it would take about four hundred and fifty to make a pound. It feeds on copepods, sagitta and other minute plankton fry, and from this food it generates energy to live, to fight, to migrate up and down, to keep illumined one hundred lights and to lay upwards of seventeen hundred eggs.

Scattered over the body are many small, round, luminous organs, which we may divide into three general sets. First, thirty-two ventral lights on each side of the body, extending from the tip of the lower jaw to the base of the tail; second, twelve lateral lights arranged irregularly along the head and body, and third, a series of four to eight median light scales, either above or below the base of the tail.

The light scales of the tail are apparently of great importance. Ordinarily when the whole fish is glowing with the pale, cold greenish light of luminescence, these caudal lights are seldom seen. A clue to their use is to be found in the fact that they show a remarkable

A Scarlet Pacific Octopus which can change its colors rapidly from scarlet to pink to rose to white.
From a drawing in water-colors by Isabel Cooper.

sexual difference, the males having them on the upper side of the tail base, and the females on the lower side.

The luminescence of the scale search-lights was a much deeper green than the ventral lights. If continuously alight, a single fish would enable one easily to read fine print.

In the dark it was thus possible to distinguish species of lantern fish by the lateral hieroglyphic heliographs and the sexes by the upward or downward direction of the tail lights.

An hour or two after the first Myctophids had come to the surface, I would occasionally find a somewhat larger, black fish among them. In the glare of the laboratory electric lights this was not a very unusual-appearing fish, although it had a short, dependent chin tentacle and a mouth with exceedingly wide gape. It was a fish named *Astronesthes* (Bull. Sept., 1925), and for once the ichthyological Adam had showed imagination, for these Greek words mean "An eater of stars." Not until I dissected one did I realize the full significance of this title, for in each *Astronesthes* I found a full-sized, just swallowed lantern fish, Myctophid, although the former was only about one-third longer than its prey. In the dark, this voracious black fellow was a gorgeous sight, the skin covered with a host of minute luminous specks, while the fins fairly glowed with pale green light. Curiously enough, it was the stem and not the specialized tip of the chin tentacle, which was luminescent.

COCOS—THE ISLE OF PIRATES

* * * * The sea is mirror calm with only the silent slipping past of lazy swells, more like evanescent breaths on glass than actual movement. So clear and blue and still is the surface that I cannot tell where the liquid begins and the air ends. The air is quiet and neither hot nor cold, and the world is perfect, with all mankind and his works out of sight behind me.

Five distinct and separate smudges of rain beaded the horizon, and as my eye played idly over these, one cloud lifted with amazing rapidity and revealed Cocos Island, clear and green.

I climbed at once up to the bow where I commanded a wider prospect. As Cocos—alive with legends of pirate hoards of gold, with every headland and inlet named after some brigand of the sea—as Cocos appeared before us, our escort began to form. As we neared it, great numbers of dolphins—those souls of drowned sailors—raced toward us in tens and tens and twenties, and gathered in all but solid layers about the bow and along the sides. I have never seen such hosts packed together.

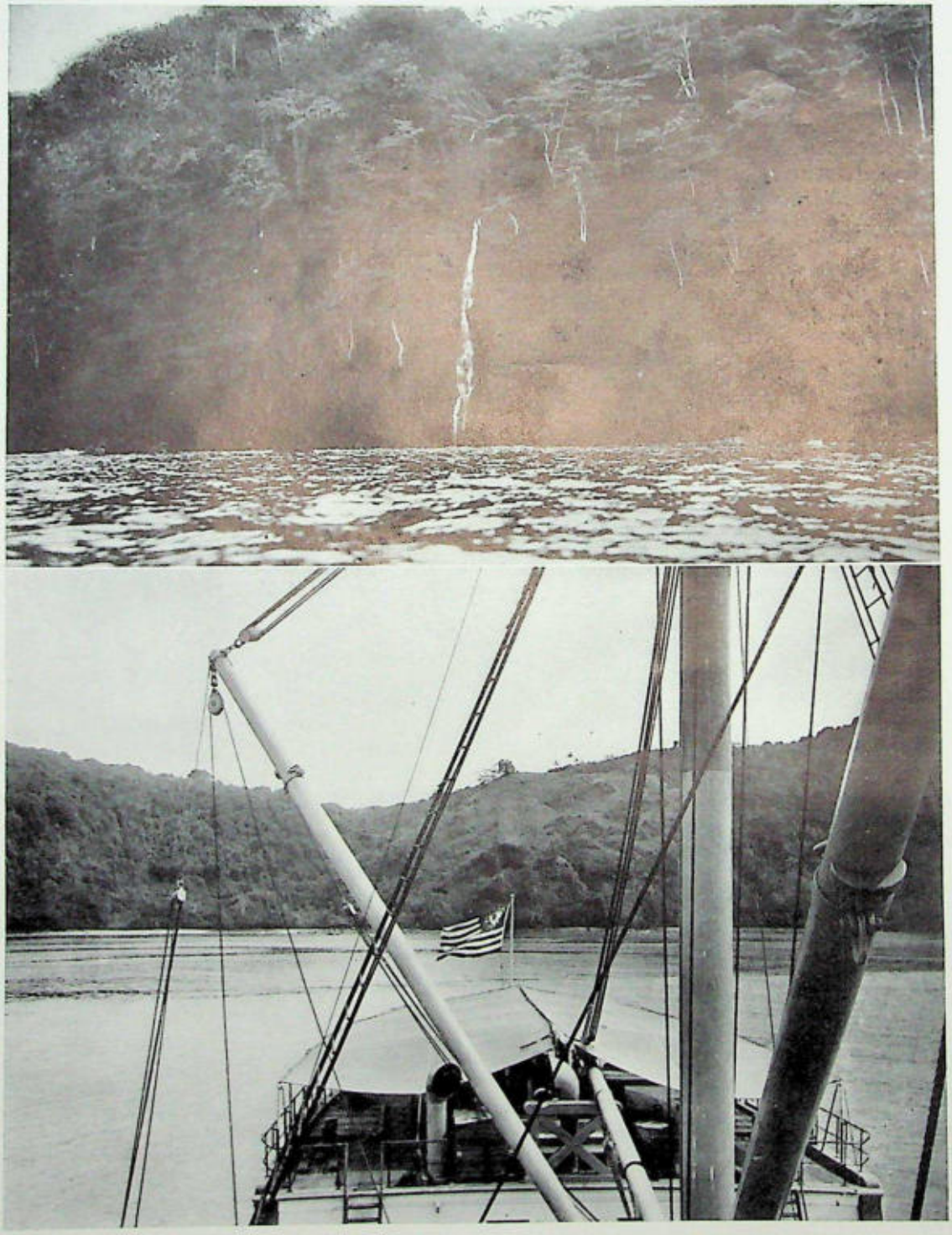
Long before the island showed any detail, boobies—the long familiar red-foots, and a wholly new green-foot—hailed us as the newest things in convenient perching places, and the best dead trees they had ever seen, and our ratlines and wireless were crowded so that the birds touched each other. A few frigatebirds passed, some pure white terns swooped in the distance and—Cocos vanished. Over it, dark clouds materialized out of nothing, and the smoothness of the forested mountains became blurred and streaked with rain. Then a great curved arch of pale grey etched into the black rain cloud, a stain of some indefinable color appeared, deepened and the island was crowned by a rainbow so brilliant that its edges seemed to carry human vision much farther along the scale than usual,—our eyesight almost interdigitating with heat on the one side and sound on the other.

The discoverers of the Galápagos did not think enough of their find to attach a name to those islands which they were the first to see. But the man who discovered Cocos was even more indifferent, for he appears not to have so much as mentioned the circumstance that he had chanced upon this scrap of tropical jungle, afloat in the Pacific, far from sight of any other land.

No doubt Cocos was fortuitously found, perhaps by some Spanish captain exploring the new domains of the mother country, perhaps by a filibuster fleeing with booty from the mainland. Surrounded by strong and tricky currents, concerning which much remains to be discovered, and very often veiled by such heavy mists and rainstorms that a ship may pass within a few miles without glimpsing a trace of land, the very existence of such an island has been denied in comparatively modern times.

At last Cocos came out fresh and green from her shroud of rain, and we slowed, sounding every few yards, drifting nearer and nearer until the heights of Nuez Island were well abeam to starboard, and Cocos itself loomed high over us.

It rose before us tiny and mountainous, only about three and a half miles across, with two peaks in sight, deep-seamed with ravines, one



The *Arcturus* anchored at Cocos Island. *Upper*—Mountain torrent pouring down the side of Cocos Island. *Lower*—Chatham Bay, Cocos Island, from the *Arcturus*.

of which was almost twenty-eight hundred feet in height. No greater contrast could be imagined than between Cocos and the Galápagos—the one wet and green, the others dry and brown.

Dawn broke with the silent impetus of the tropics, and breakfast on this day lost all hint of a social rite, and became a hastily performed physiological necessity.

As our little outboard motor vibrated rapidly across Chatham Bay, great shadowy forms passed beneath, and now and then we had to snap the tiny propeller out of water as a giant grouper made a rush for it. Smooth white sand alternated with coral skyscrapers and volcanic villages, fathoms beneath the clear water. At the head of the bay series after series of great rollers curved and broke, and choosing the eastern side where the surge struck obliquely against a line of mighty lava boulders, we tumbled ashore in the breakers and crept up the pebbly beach.

Wherever we went the way was barred by vegetation through which we had to force our way. The only passable paths were up the center of the rocky streams which leaped and swirled down from the high interior. Four-fifths of the island is on end, with slopes so steep that the trees are set in at most acute angles. The rain which falls heavily for many months of the year keeps the island as saturated as a sponge, and the squashy yellow clay and dripping vegetation seem seldom to become even approximately dry.

Along the shore were groves of giant tree-ferns whose lacy foliage fretted the sky overhead. Every now and then a silver column of water would appear, falling from high up on the mountain, to spend itself in spray and a trickle over the pebbly beach. The sun came out and the whole island glistened like a jewel with a myriad facets. Great orange and black brassolid butterflies hovered about the masses of morning-glories, Hibiscus and Clusia blossoms near by, while seaward the view was seamed by a hundred vertical lines of aerial rootlets, dropping from fig-trees high above.

A sharp cry drew my attention to a bird swinging in a curve out from shore, sandpiper fashion, and when it alighted I knew it for a wandering tattler. Then a black spot on the sand exposed by the ebbing tide turned out to be a grey Galápagos gull. It was pecking at an old fish, and as I watched I saw a small something run a few feet away. My glasses showed a large rat—apparently of the usual ship's kind.

There are only four species of land birds on Cocos and later in the morning, within a period of fifteen minutes, I saw all of them without moving from my boulder. A flash of rufous and a throaty note revealed the only species of insular cuckoo, my warblers were all around me, and then there came to my ears the sharp snap of a bird's beak and on the tip of the barrels of my gun which I had left propped against a rock perched the Cocos flycatcher, hardly to be distinguished from the little olive green Galápagos chap. In silence, finally, came a small flock of the only finch, anomalous little birds with rather slender curved beaks, the males in black, the females mottled with olive and buff as though permanently saturated by the everlasting rain.

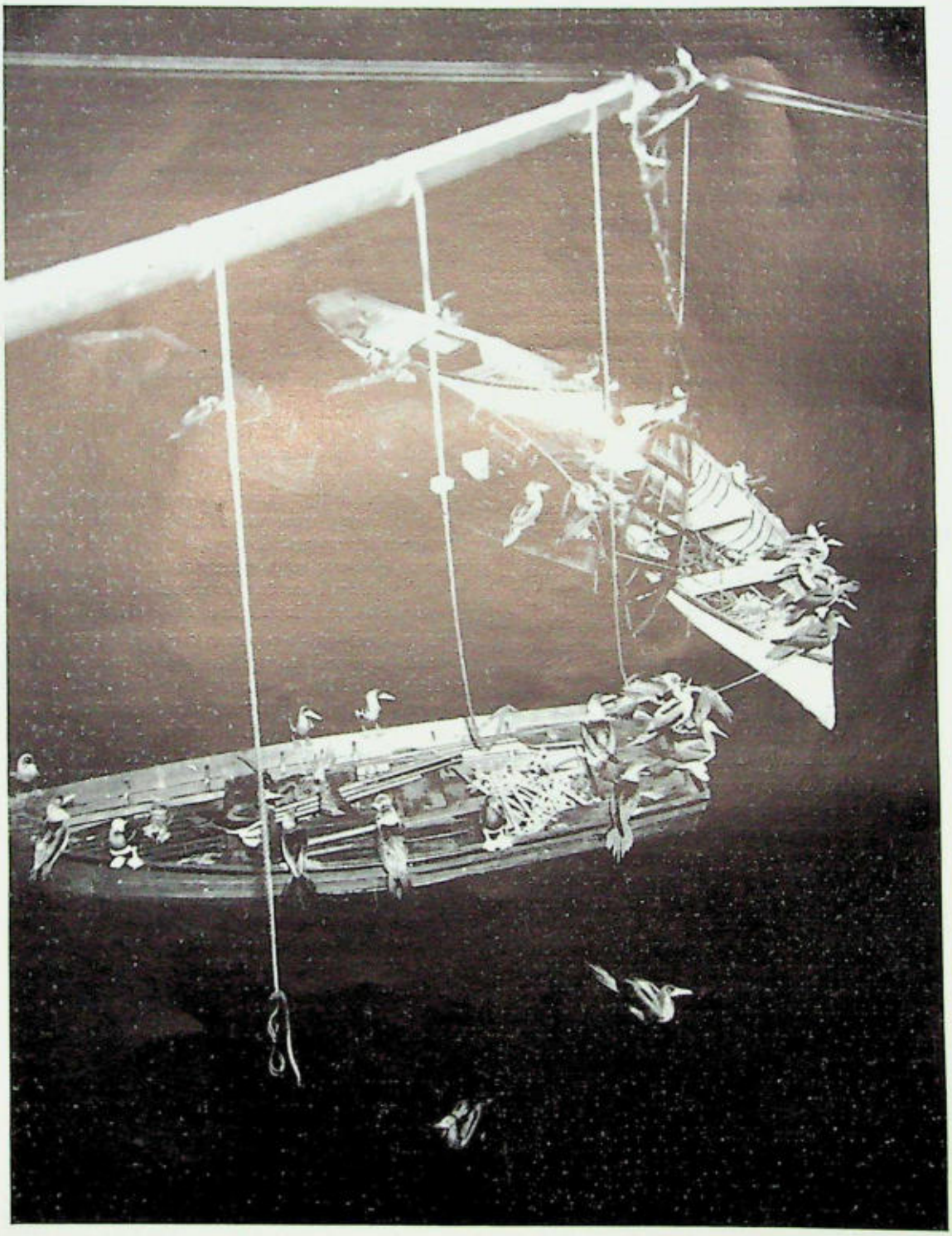
A favorite feeding ground was at the limit of high tide where I saw all but the cuckoo again and again. Here, too, came the ugly rats and twice we saw domestic cats, quite as wild as leopards, tearing at decayed fish, snarling at us and dashing away at our approach. On almost every tree were little Anolis lizards, scampering up and down the bark, and in flecks of sunlight expanding their relatively enormous, flat, bright yellow throat wattle both to charm their mates and intimidate their rivals.

I picked out the nearest ridge summit and struck upward along an open grassy slope which, from the *Arcturus*, had looked like soft clover. In reality it was far different—a sort of elephant grass, six to eight feet in height, with a saw-toothed edge which would cut to the bone if rubbed the wrong way. When we reached the summit I decided to return by a circuitous route through a deep, jungle-filled gorge.

Here we had only to slop and slither through the ferns and mud, now and then disentangling a rope-like liana which threatened to handcuff or garrot as we descended. Overhead we watched most curious sights. Here were hundred-foot trees growing so densely that the sunlight was dimmed to twilight, and high up on the topmost branches were perched scores of seabirds—frigatebirds, boobies and pure white fairy terns.

On our way down we spread a small net across narrow reaches to the torrent and caught great crayfish and curious little, vacuum-cupped gobies. Once we saw a giant a foot long, and on another day captured it.

I was astonished at the abundance of insect life, for other explorers of Cocos unite in dwelling on its scarcity. We took moths, large and small, including two species of beautiful, pink-spotted sphinx, several kinds of butterflies, and large brown-winged grasshoppers.



Cocos Island Boobies in a terrific storm, taking shelter in the *Arcturus'* boats. Throughout the entire night, boobies by the hundred, and noddy terns by the score lost all control of themselves when they came within the glare of the ship's electric lights. From a flashlight photograph taken from the *Arcturus*.

Throughout this entire night of storm boobies by the hundred and noddy terns by the score flocked to the steamer, covering the deck and filling the boats. They seemed to lose all control of themselves when they came within range of the glare from the electric lights. Yet they did not dash into the light, but merely alighted near it and remained quiet, or flopped about and fought with each other. Nothing showed the complete absence of man from this island as much as this. The terrific wind and blinding rain utterly confused the birds. All doors had to be closed, for they otherwise filled the staterooms and

On my return to the *Arcturus* I frightened up a quartet of yellow-legs which flew after the tattler, and high overhead a hawk circled, the only one ever recorded for this island. The motor boat was anchored out beyond the surf and after fighting my way through the breakers and reaching the bow I saw a small green heron rise from the stern.

It was as well that I returned when I did, for by the time I reached the *Arcturus* a wicked blue-black squall was headed for us, and the waves were too high and choppy to be safe for a small boat.

About nine o'clock at night the wind arose in earnest and was soon blowing half a gale. All the boats were tied alongside, rocking and pitching in the rising waves. Our lights were all on and the brilliant glow made the surrounding darkness all the more impenetrable.

The boobies were so tame that they perched fearlessly on the *Arcturus'* rigging and sat quietly even when approached by Miss Rose. In the lower picture are terns of Tower Island, Galapagos.

laboratory, and their long, thrashing wings worked havoc until we ousted them.

These birds nested by the hundred in low trees along the shore of Cocos, and were now returning from their fishing excursions to relieve their mates. The food was chiefly small flying fish, half-beaks and squids, with a scattering of smaller species, especially *Ophioblenny*.

Next morning the sun rose in a blaze of golden copper—a third of the sky being molten, the rest cold blue, while to the west beyond the island was the inevitable rainbow with its end buried deep in some inland ravine.

The water-falls on the mountain sides had increased to foaming torrents, and tide lines

(*Continued on page 62*)

New York Zoological Society

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A PUBLIC ZOOLOGICAL PARK. ¶ A PUBLIC AQUARIUM. ¶ THE PRESERVATION OF OUR NATIVE ANIMALS. ¶ THE PROMOTION OF ZOOLOGY.

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"A WILD ANIMAL ROUND-UP"

A Review of Dr. Hornaday's Latest Book

By WILLIAM BEEBE

Any one of Dr. Hornaday's books is difficult enough to review, because the activity of his mind shows up the particular subject of the volume in so many diverse lights that a critical estimate of one page or chapter is inadequate for succeeding ones. But the present work, "A Wild-Animal Round-Up," is still more baffling in that it is exactly what the title suggests—a mental round-up of a great diversity of experiences selected from the long and adventurous life of the author. The only thing with which I can compare it is the memory of a wide swath through palmetto scrub which John Burroughs and John Lewis Childs and I watched many years ago in Florida. The scrub to the south had been fired, and before the onrushing, crackling flames there fled a host of two and four-legged creatures, which ran, or crept or half-flew across the open space, before our eyes, to safety. Thus, across the pages of Dr. Hornaday's book there pass in review buffalos, elephants, cave-birds, bear, and mountain sheep,—then visions of the same and other animals contentedly living in zoological parks, and finally studies of their mounted skins in superb museum groups, and their forms living again in wild-animal photography and motion pictures.

Like Gaul, the volume is divided into three parts, "Diversions in Picturesque Game-Lands" where in ten chapters the author recounts pleasant reminiscences of last buffalo hunts, adventures with the guacharo-birds of Trinidad, with crocodiles, and of the glories of camp life in western bad-lands, the Shoshone Mountains and Mexico. Another half-score of chapters deals with the vanishing of wild life on the earth,—elephants, caribou, mountain goats, muskoxen and grizzly bears.

Finally, the masterpieces of American taxidermy and wild animal photography are presented, and Dr. Hornaday's own great masterpiece, "The Making of a Zoological Park." For the most part the titles speak for themselves and few readers need any introduction to the vividness and reality of the author's style. But the portion of greatest interest to me concerns the disappearance of wild life, which is indeed the key-note to the whole book. Read two paragraphs from the preface, "In God's Outdoors the old order of things is passing away, and all things are becoming new. Is it for better or for worse? Really, if you but stop to think about it, you will find that the extent and thoroughness with which the once lovely face of Nature now is being sacrificed and disfigured by the hand of man, is amazing or worse.

"We who are responsible for this volume feel that there are a certain number of old-fashioned nature-lovers who will care to have these animal-records of yesterday, and also of today, in form for the library shelf. It will not be many years more ere the most beautiful haunts of Nature are ripped open by improvements, sacrificed by roads and tourist camps, and everywhere infested by rushing automobiles. Already the wild beasts have fled to the remote recesses of the second-hand forests. The game-birds are fast going down before the 6,000,000 American guns. I fear that even ten years from now there will not remain enough wild animals in the outdoors to salt their pallid flavor, or to interest our pleasure-mad young

And again, more definitely, on page 204: "There is one danger of which all elephant-owning countries in Africa must beware. That is the owning and use of modern high-power rifles and fixed ammunition by natives. I speak of it here because of the new modern rifles recently obtained by the Arctic coast Eskimos, who, with them, *already* have exterminated the muskox of the Canadian Barren Grounds, save an estimated one hundred or less.

"A hundred years from now Africa will be swarming with white people, gridironed by railroads, crowded with automobiles, and dotted all over with cities and towns. Then there will be five million rifles and pump-guns in use, and one or two of the Africanders who have no commercial interests at stake will be regretfully writing about 'Our Vanished Game.'" Dr. Hornaday's account of this depressing subject is full of unexpected interest and anecdote, as when he says, "To-day the greatest herd of bison in the world is the Canadian national herd at Wainwright, Alberta, where about seven thousand four hundred and eighty-nine head are kept in a huge buffalo park of one hundred and sixty square miles under fence. The great herd was founded away back in the seventies on the love of a young Flathead Indian named Coyote for a Blackfoot Indian girl." But the story is too good to excerpt. Get a copy of the book and read it for yourself.

"Game-eating Adventures" is a chapter that appeals especially to me, for like Dr. Hornaday, I always like to try new and strange dishes. I think "long pig" is the only thing I have not yet sampled. I agree heartily with him when he says, "A few days later I ate my first argus pheasant, at the head of the Sibuyau River; and it was truly fine." And again, "The very best thing is curry and rice, which only one Western cook out of fifty millions knows how to make á la India." But I quite disagree with him when he writes, "The howling-monkey, from the same region, has a strong and disagreeable wild-animal odor, and it would be a bold and hardy experimenter who would attempt to eat the flesh of an adult." I and my entire staff at Kartabo, British Guiana, have eaten several dozen full-grown howling-monkeys, have found them quite free from unpleasant gaminess, and have invariably come back for second helpings.

All a reviewer can hope to do with this volume is to emphasize its remarkable scope and its wide diversity of interest. For example, in the chapter on "The Bad-Lands of Hell Creek," we have exciting accounts of mule-deer hunting, of cow-boy psychology, of excellent landscape description, of wild mice which filled the back of a buggy with stored seed and baby mice, of a *Triceratops* horn which led to an important discovery of deposits of fossils, and finally, let the author himself tell you of the camp owl: "Our camp was exceedingly comfortable, and also interesting. Our tent stood within seventy-five feet of the high cut-back on the opposite side of the waterless creek, and in a cozy niche of the earthern wall there lived a fine old western horned owl. His sconce was only about twenty feet up the wall, and there he sat, every day, meditating and blinking away the hours. His working hours were from sunset until sunrise. During the daytime he always seemed happy to meet those who called upon him, and occasionally hooted vigorously, *in broad day*—not necessarily for publication, but to guarantee good faith. I can hear even yet the hollow and sepulchral reverberations of his greetings."

The age of possible production of books such as this is past. Wild life will have to be studied more and more in preserves and zoological parks, and we should treasure every fact from the riches of the glorious past, when Dr. Hornaday, in his exuberant youth, was observing, abstracting, and keeping journals of all the worth-while facts which came to his senses, as well as taking his share of legitimate shooting. Only an experienced and temperate sportsman is worthy of sending forth such a warning as this, all the more forceful because it is indirect, to modern pot-hunters and game-hogs, as well as to gentlemen sportsmen, less wise and thoughtful than they should be.

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The *Arcturus* at anchor off the tree-clad shores of Cocos Island, and the diving helmet used to explore its sharkful depths.

were conspicuously marked with floating tree-trunks, branches and vines, and millions of green leaves, extending in a straight line along the axis of Chatham Bay and on the northern horizon.

Man has had so little to do with this speck of an island that all the historical facts we can gather are of interest.

As nearly as 1600 the Dutch circumnavigator, Oliver de Noort, tried to find Cocos and failed, and in 1615 another Dutchman, George Van Spilberg, wishing to get coconuts and water there, missed it because he had its position as south of the line.

In 1684 Dampier had a similar experience aboard the *Batchelor's Delight,* so we lack the careful and accurate account which this conscientious observer would no doubt have written. Instead he quotes hearsay:

"The Island Cocos is so named by the Spaniards, because there are abundance of Coconut Trees growing on it. They are not only in one or two places, but grow in great Groves, all round the Island by the Sea. This is an uninhabited Island, it is 7 or 8 leagues round, and pretty high in the middle, where it is destitute of Trees, but looks very green and pleasant, with an Herb called by the Spaniards, Gramadael. It is low Land by the Sea-side."

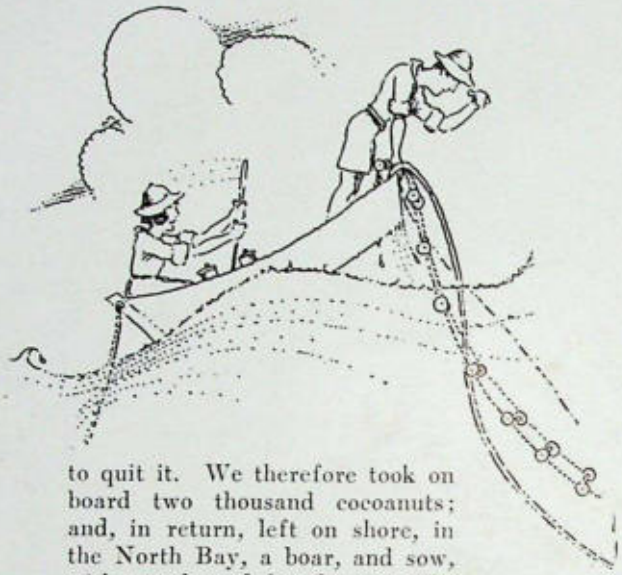
. . . Clipperton was the next famous person to visit Cocos. He was there in December, 1720, and January, 1721, and the record of the voyage is quoted from a book by one William Betagh, captain of Marines with Clipperton's expedition.

In 1740 Anson sighted the island but did not attempt to land, altho his ships needed water. A scepticism which was unfortunate, in this case at least, kept them from benefitting by the lavish supply of precious water, and is voiced by Richard Walter in his record of Anson's voyage: "Indeed there was a small island called Cocos, which was less out of our way than Quibo, where some of the Buccaneers have pretended they found water."

In the summer of 1793 Colnett was here on the *Rattler,* on a voyage which had for its purpose the extension of the spermaceti whale fisheries, and the investigation of anchorages which would be useful to the whaling fleets. He had come from his first visit to the Galápagos, where he christened Hood and Chatham Islands, when he stopped at Cocos.

Captain Colnett has left us a long, accurate account of his visit of Cocos, much of which has to do with helpful suggestions for future visitors. He suffered almost continual rain during his stay at the island, and concludes:

"We were much wearied, during the four days, we passed off this island, and prepared



to quit it. We therefore took on board two thousand cocoanuts; and, in return, left on shore, in the North Bay, a boar, and sow, with a male and female goat. In the other bay, we sowed garden seeds of every kind, for the benefit and comfort of those who might come after us. I also left a bottle tied to a tree, containing a letter. Over it I ordered a board with a suitable inscription, which Captain Vancouver thought proper to remove, when he anchored at this isle, some time after me."

Colnett and Vancouver were shipmates under Cook on H.M.S. *Resolution* in 1772-1775, Colnett as midshipman, Vancouver as able seaman. But when, in January, 1795, Vancouver, returning from the Sandwich Islands with the ships *Discovery* and *Chatham,* put in at Cocos for water and found the letter left by Colnett two years before, he betrays no sign of ever having heard of the man before.

Chatham Bay was named for Vancouver's armed tender, which lay at anchor there.

It is to Sir Edward Belcher in his Majesty's Ship *Sulphur* that we owe the survey of the coast of Cocos, which is the basis for most of the charts of the island. Although Belcher made his maps in 1838, there is to this day an incomplete portion on the south marked "uncharted," a striking illustration of how little interest has been taken in this isolated spot,—at least from any point but that of treasure-seeking.

It is worthy of note that although Belcher was here almost twenty years after the supposed date of the burial of the first lot of treasure, he makes no reference to it, and it is fairly safe to assume that he had not heard of the hoard. Probably the fame of Cocos, until the time of Keating's discovery of treasure in 1845, rested wholly on the ease with which unlimited quantities of sweet water could be obtained, and during the years of the whaling industry, it was a resort of ships, a place of rest and refreshment, a place to explore, in the intervals of getting wood, water and coconuts aboard.

One of my last memories of Cocos is the most dramatic. I rowed across to the west side of Chatham Bay close to Nuez Island. This is a very lovely sliver of land, a few hundred yards long and with a steep, high ridge, the underlying rocks showing through the foliage—white shoulders through a tattered coat, while, on the lower reaches, long, flowing grass clings like the exquisite emerald pelage of some somnolent behemoth. The figs and other trees drop showers of aerial rootlets which drape the island like gigantic beaded portières.

I anchored the flat-bottomed diving boat fifty feet off shore in the quietest spot I could find and then submerged in about thirty feet. Visibility was remarkably good and I could see clearly for one hundred feet in every direction. On one side enormous boulders piled themselves up higher and higher until they crashed through into the air and on up the slopes of this isle of death. In other directions the bottom sloped gently but steadily downward until it was lost in mysterious blue depths toward the abysses of the sea.

The swell was heavy and the end of my swaying ladder reached alternately from twenty to within ten feet of the bottom, as the boat rose and fell on the surface. I knew my leaping ability in this gravitationless medium so I did not hesitate to drop from the lowest rung at the moment when it was nearest the coral floor. I landed on a table of lava and was at once the center of a school of great grazing fish, triggers, parrots and surgeons, the largest I had yet seen, with now and then a unit of swift carangids, gleaming like purplish jade as they shot past. Out of the blue distance there materialized a man's length of white-finned shark, then another and another, until sixteen were milling slowly about between me and the surface. This was a new habit and an unexpected formation of these fish and I must admit that the ladder looked very long and very high above me. I was so uncertain of

A tropic isle. Wafer Bay, Cocos Island where a fresh-water stream flows over the beach into the sea near one of Captain Gissler's cocoanut palms. The island was named Cocos by the Spaniards because of the abundance of the "Cocoanut Trees" growing on it.

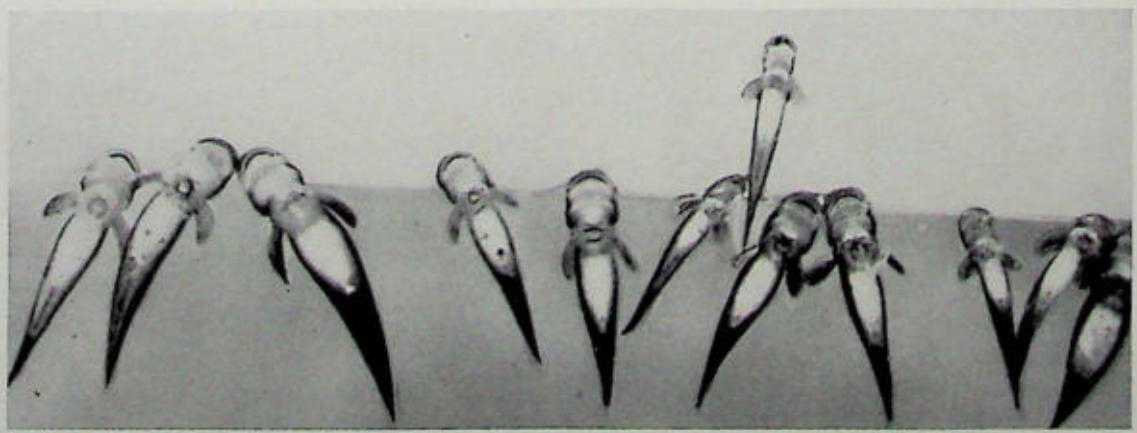
an unexpected formation of these fish and I must admit that the ladder looked very long and very high above me. I was so uncertain of the significance of this gathering that for a time I crouched in a circular cavity between two great coral growths, with my helmet in the entrance like a cork in some astounding bottle. The sharks showed no more than curiosity and, as usual, I was much more concerned with the ugly four- and five-foot groupers who pushed their unpleasant mouths within a few inches of my body and limbs. But when I saw the pigfish and the angelfish swimming unconcernedly about, I took heart and strode forth.

In the dim distance I could see a very beautiful sea fan and started for it. Never, even in the high Himalayas, have I ever breasted so stiff a wind as the push of this current which swept past Nuez. At times I was lifted clear off my feet and carried back. Twice I found myself at my starting point. So I went down on knees, and with fingers and toes clung to every step which I gained. With me went the brobdignagian groupers and the lesser fry of angelfish and always overhead circled the sharks. My hose had trailed behind now and was no longer the hub of their orbits. For a while I was the center of attraction in this part of the Pacific Ocean.

After much effort I reached my sea fan and hung on to it while I floated in mid-water, waved about by the current like a rag on a bush. My body-guard had thinned out, and twisting around, I saw a tiger shark weaving slowly toward me. I would gladly have given my place to any eager scientist in the world, or relinquished it to one of the thousands of men with more courage than I possess. But at least I was not bothered with a choice of action —there could be no thought of escape by flight. I crouched close to my wisp of sea fan, although hiding behind it was as effective as an attempt to conceal oneself behind a handful of ostrich feathers.

The shark appeared enormous—thirty feet came to my mind. Then, like Dunsany's ghost-watcher at the Castle of Oncleigh, I sought to distract my fear with geometry. I estimated the shark's length, I compared it with other fish near it, and I was more composed by the time my mind settled on eighteen feet as the extreme length I could assign to it. I had already faced scores of sharks and even other tiger sharks in my diving, but never so large a one, nor in such unprotected surroundings nor without at least grains in my hand. The great elasmobranch came on until I could see the black veins in its yellow, cat-like eyes, and the loose, adenoid-gape with its lining of triangular teeth. The mighty tail swept farther to one side, the shark veered—and passed. An unusually heavy surge once carried it far back toward me, but it never turned and soon vanished beyond the shadow of the boat.

When I breathed slowly again I braced myself and with all my might dragged the animal bush from its moorings, and waving it like a purple banner, I returned, leaning hard back against the current. With no take-off except a low crouch I leaped upward and slowly rose through eight or ten feet of water and seized the lowest rung. For a while I hung there, soothed by the lift and settling of the deeper curve of successive surges—surges which, fifty feet away, were crashing into foam against the



Cocos Fresh-water Gobies, *Cotylopus cocoensis* clinging to the aquarium glass with their ventral suckers.

An interesting picture of whistling swans photographed by a Detroit News photographer from a blind in the marshes at the mouth of the Detroit River, Michigan

cliffs of Nuez. I looked around at the scattering hosts of *Xesurus*, triggers and angelfish, watched a trio of sharks meandering casually along beyond them, and, with a final gasp of wonder at it all, for the last time in these waters I climbed until my upraised hand thrust the great purple sea fan into the open air.

THE WHISTLING SWAN'S DETROIT STOP-OVER

An Interesting Contribution from the "Detroit News"

THIS unusual photograph of whistling swans was taken from a "blind" at the Monroe marshes, adjacent to the mouth of the Detroit River in Michigan. For the past five years the northern migratory flight of these majestic birds has increased in numbers throughout this territory. Ten years ago the sight of a "whistler" in this section was cause for wonderment. On the stop-over this spring, the various flocks have been estimated to number as many as 7,000 birds. Of the two species of swans native to America, the trumpeter and whistling, the former is almost extinct. For the latter, a ten-year closed period on hunting is accountable for their gradual increase in numbers.

In size this swan is larger than the well-known Canada goose. It is pure white, in plumage, with black bill and feet. It secures its food from the marshy areas frequented by our mallards and pintails. It never dives for food, and seldom resorts to the duck method of "tipping-up," for its neck is sufficiently long to permit it to reach the bottom of the ordinary shallow marsh.

This photograph was taken by a staff photographer of *The Detroit News*.

"A NATURAL HISTORY OF THE DUCKS"

Review of John C. Phillips' New Monograph:

By WILLIAM BEEBE

BOTH John C. Phillips and the ornithologists of America are to be congratulated on the completion of Mr. Phillips' superb monograph, "A Natural History of the Ducks," published by Houghton, Mifflin & Co. The first volume appeared in 1922 and the fourth has just been received in early April.

It is a joy to turn the pages of a monograph for a worthy comparison to which we must look backward, passing over the age of pictorial, but factually arid, tomes, to the days of Audubon, when the words "monograph" and "natural history" had more in common.

Phillips has done wisely in commanding the services of not one, but a quintet, of artists—Fuertes, Benson, Brooks, Grönwold and Kobayashi. I never regretted doing the same with my Pheasants, and when all are artists of the first rank, comparisons are only mutually beneficial, and the resultant variety adds inestimably to the beauty and value of the whole. There are one hundred and two full-page plates all told, a goodly majority being in color, and the work is confined to the pukka ducks,—geese and swans being omitted.

With practical binding of grey canvas, convenient 9 x 12 inch pages, good paper and type, and a thorough bibliography and index, Phillips has disarmed all but constructive criticism in the general make-up of the work.

Taking Volume IV as typical of all, Mr. Phillips has treated thirty-one species, including the scoters and eiders, the ruddy and musk ducks, the curious torrent ducks and the mergansers. Thirty-two plates illustrate these in whole, or their bills, legs and young in down, and twenty-three double-page maps orient us as to their distribution on the surface of the earth.

The torrent ducks are among the most remarkable and least known of the groups, and every word of information about them is valuable. They haunt the swiftest of mountain torrents in the Andes. Concerning the Chilean species Phillips quotes, "It lives in the wildest streams and is never seen excepting on rocks in mid-stream or bobbing along in the torrent or flying back up-stream. They move down-stream and fairly jump out of the water to the steep up-stream side of a boulder, and stick exactly like a woodpecker on a tree, their stiff tails being their means of support. I never saw them in a stream which did not flow far too fast for them to swim up-stream, so they fly back. In a country where man is seldom seen and where all other birds are as tame as birds in a city park, these ducks are as wild as can be and I had fairly to stalk them to get a shot. Many I never recovered. I found that they ate mollusks, including gastropods, from stomach examinations." They lay but two eggs. The colored plate by Allan Brooks of the Peruvian Torrent Duck is one of the most charming in the entire monograph.

For consideration of general treatment let us take the common Red-breasted Merganser, *Mergus serrator* Linné. After the synonomy,

Family of Peruvian Torrent Ducks *Merganetta leucogenys*
A plate by Allan Brooks from a Natural History of the Ducks by John C. Phillips

Phillips lists no fewer than one hundred and fifty names taken from twenty-nine languages, from English to Esquimau. Then come detailed descriptions of all stages and phases, and the cosmopolitan distribution in great detail, with exact references. Migration naturally follows. This is all in fine type.

Ten pages of general habits complete the account, this being broken up into the following sub-headings: Wariness, Daily Movements, Gait, Swimming, Diving, Flight, Association with Other Species, Voice, Food, Courtship and Nesting, Status, Enemies, Damage, Food Value, Hunt, Behavior in Captivity, and Hybrids. This will give an idea of the thoroughness of the work. Not only, however, are the facts compiled and collated, which any painstaking library searcher could do, but they are logically arranged, and transcribed into excellent English, losing nothing in scientific accuracy because they appeal to the ardent bibliophile, the lover of literature, the serious aviculturist, the keen sportsman, the enthusiastic naturalist, as well as the intelligent layman. I am grateful to Mr. Phillips for the crystallization between book covers, of human knowledge of one of the most splendid groups of birds living with us on the earth to-day.

UNUSUAL DEEP-SEA CRUSTACEA—SOME FORMS SECURED BY THE ARCTURUS OCEANOGRAPHIC EXPEDITION

By Lee Boone

THE lore of the ancients is alluringly mosaiced with fragments of sea-mystery in the form of legends of the littoral and pelagic crustacea, such as the "lobster" gargoyle of immemorial Chinese temples, the sacred "I-ban-you" of Japanese altars, the great crabs of the Nile, carven sentinels of age-crumbled Egyptian obelisks, the *Cancer* of the Arabic zodiac, the less known crab-god of the ancient Mayan peoples, the sacred crab of the Polynesian legends, the "sea-elephants" of Pliny and the unforgettable tales of the Viking rovers. Modern museums have entombed in sealed jars and epitaphed in sonorous cryptic monographs the results of the pioneer oceanographical expeditions of the past half-century, but our knowledge of the far more fascinating life histories of the deep-sea crustacean fauna is necessarily the imperfect product of kaleidoscopic glimpses obtained from the startled contents of dredge hauls.

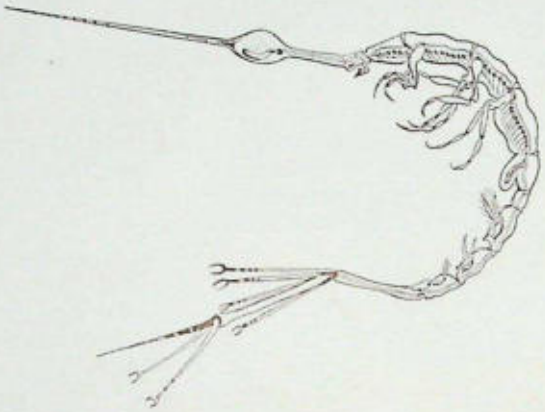
The Arcturus Oceanographic Expedition has endeavored to present its zoological collections not merely as specimens but as living organisms and to bring before the public, so far as camera and pen can portray, the ethereal opalescent beauty and miracle of grace which personify these children of the sea.

The log of the Arcturus records "stormy weather of unusual severity" during the explorations of the Sargasso Sea, yet 95 per cent. of the known crustacean fauna of this area was secured and color plates of the various species were made showing the marvelous range of adaptation to their surroundings evolved by these tiny creatures. Hitherto unrecorded data of the breeding habits and larval stages were secured of even such well known forms as Columbus' crab, *Planes minutus* (Linnaeus), which is probably the oldest recorded crustacean of the New World fauna, for as stated by Hans Sloane (1705): "Columbus on finding this alive on Sargaffo floating in the Sea, concluded himfelf not far from fome land in the firft voyage he made on the difcovery of the Weft Indies."

The few hours devoted to collecting at Colon resulted in a representative series of specimens typical of this faunal area and added thereto several new distribution records, one of especial note being twenty specimens of the graceful *Lupella forceps*.

However, the richest hauls of the crustacea were made in the Pacific, the majority of the specimens which were taken being representatives of very rare or new forms which will be fully described in a report now in preparation. The intensive research conducted at Station Seventy-four, a point in midocean about sixty miles south of Cocos Island, was rewarded with representatives of approximately 80 per cent. of the species of Crustacea secured by the Expedition in the Pacific.

The photograph (page 72) shows the staff of the *Arcturus* sorting the catch listed as "Station 74, Otter Trawl 3, Depth 624 fathoms," but which seemed as it came over the ship's side a veritable argosy of iridescent rainbow-clad emissaries from Neptune's court, who fascinated

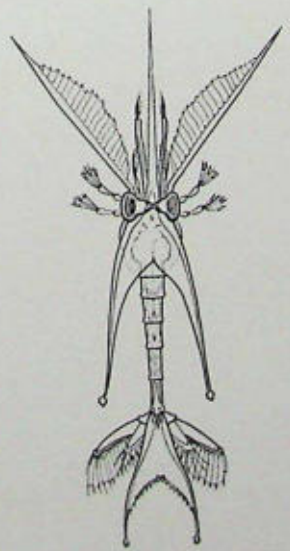


An oceanic crustacean—*Oxycephalus*—with eyes all over its head. From a pen drawing by Don Dickerman made from a specimen taken by the *Arcturus*.

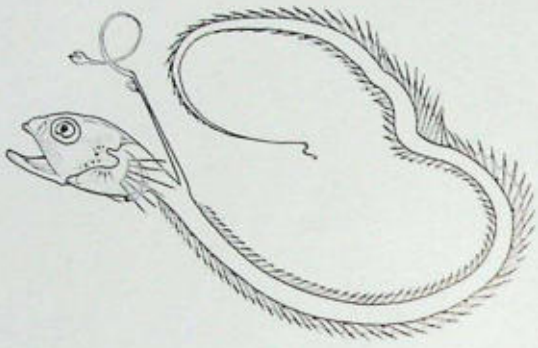
us with their indescribable gracefulness and thrilled us with the tantalizing fragments of stories they told of their life under-sea.

There were opalescent *Gigantocypris*—as astounding a surprise as if one met an ant a yard long; scores of scarlet armored *Heterocarpus* with swordlike rostrum half as long as the body, and slender, sensitive, wavering antennae three or four times the animal's length; transparent amphipods who paradoxically found their strength in fragility, making their homes inside the glassy barrel-like Salpa which formed ideal "kiddie-koops" for the young amphipoda; an elegant amethystine crab whose lilac-grey eyes were set at the end of long, flexible stalks that enabled the eye to be swung in an arc with a radius of half the body length above or before the creature, periscope fashion; a weird, eyeless, claw-footed *Willemoesia* that has curiously retained the characteristics of its long vanished kin of the ancient Triassic seas; a new species of *Uroptychus*, with exquisitely sculptured body of pearly safrano pink and queer long claws that dredge the ocean floor in search of food; hundreds of swift *Benthesicymus*, vivid crimson sashed with spectrum blue; an apparently headless, multi-spined orange amphipod—a miniature impersonation of some dread prehistoric monster; countless scarlet *Nematocarcinus* whose fantastically long legs were so shadow-thin one half expected them to ballet Stevenson's nursery song; a small, globular, porcupinish *Eryonicus*, who had solved the problem of living in the great depths where the pressure is more than two thousand pounds to the square inch by evolving a spherical form and a flexible leathery coat in place of the usual rigid armour worn by his kin; a delicate, ivory-hued *Paribaccus* tinted with sea-foam green, seemingly as fragile as a bas-relief on a bubble, yet encompassing within its shadowy form the multiplicity of segments and complex nervous, circulatory, respiratory and other systems delineated in perfection of minutest detail; a group of comical hermit crabs—absurdly grotesque clowns who had cunningly hidden their weak, mis-shapen bodies under the deceptive, flower-like, death-dealing tentacles of rosy anemones—a lowly form of carnivorous animal life so named by the early Greeks because of its resemblance to this daintiest of Alpine flowers; and everywhere, jewelling the nets like fragments of girasole, were the little ostracods.

Rendered conspicuous in the colorful throng by the neutral tones of its monk-grey garb was a small, globular crab which seemed at first glance as immutable, as lifeless, as a bit of Archean rock from the ocean floor, but which, upon closer inspection, proved to be one of the most remarkable crustaceans captured by the Expedition. It is a new member of the tribe *Dromiacea*, that curious group of primitive crabs of which the little shallow water sponge-carrying crab of the West Indies, *Dromia antillensis* Stimpson, is probably the most familiar example. Like its shallow-water kin, the present species has the habit of clothing itself in foreign substances for concealment and protection but instead of the large living sponge which the shallow water species use for this purpose, holding it in position by means of the two posterior pairs of legs which have become degen-



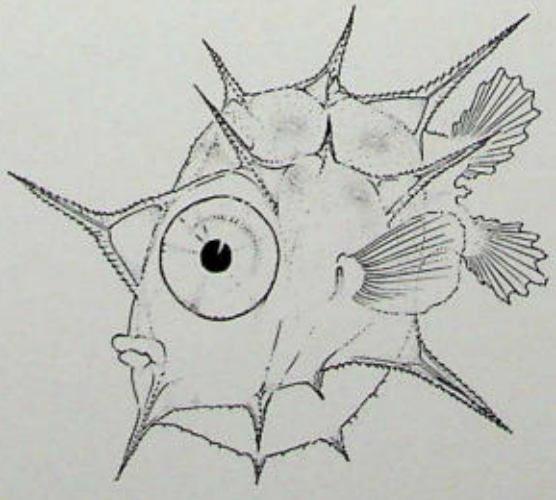
Larva of a Stomatopod crustacean. From a pen drawing by Don Dickerman made from a specimen taken by the *Arcturus*.



Sea-serpent-like larval fish. From a pen drawing by Don Dickerman made from a specimen taken by the *Arcturus*.

crate and bent upward on the back for this service, minute animals,—*Globigerina* and *Bryozoa*, sponge spicules and grains of sand and silt are utilized. These are held in place by remarkable little tree-like hairs which cover the entire crab and apparently also serve as tactile organs. Thus dressed in ooze particles the crab, which is relatively sedentary, escapes the notice of its enemies and likewise of its own prey. The two posterior pairs of legs each terminate in a three-pronged interlocking hook and probably enable the animal to anchor itself securely by a flexible, articulated hawser, while the next two pairs of legs are spidery long, flexible and each armed with a scimitar, and the claws of the first legs present the most astonishing surprise of all—powerful fingers, the lower of which divides near the tip into two, between which the curved upper interpinches! The present species has evidently long been an inhabitant of the abyss, for it has evolved in unusual degree the characteristics of the deep-sea fauna. The eyes are small, degenerate, and very restricted in the field of vision, but this is in a measure compensated by the development of exceedingly long antennae which are heavily set with plume-like tactile hairs. Similar tactile hairs fringe the mouth parts. Situated at the base of the antennae and opening just in front of the mouth cavity are the ducts from the paired luminous organs, minute mechanisms within the crab's body which possess the marvelous power of generating a substance which creates a living light. This, when released by the opening of the magical circular door to the duct which is formed by the first joint of the antennae (a segment lost in most crabs) glows like a tiny lantern and may well serve to attract a host of small creatures who are promptly devoured.

Nearby, two huge scarlet crabs sought to intertwine their long thornclad legs in the net which had so ruthlessly swept them from their familiar haunts in the realm of perpetual darkness and calm on the ooze-strewn ocean floor 624 fathoms below. We reciprocated the astonishment expressed in their startled bead-black eyes and inquiringly lifted antennae, for they proved to be a family party. The male crab was considerably smaller than his mate but this disparity was mitigated by his being clad in a more magnificent armour, the spines bedecking his elegant body were longer, sharper, and more beautifully curved, and his weapon-crested head and the meticulous precision of his every movement gave him the nonchalant air of a French Zouave. The female carried in her capacious pouch more than a thousand babies. The majority of these wee folk were not visible for she hugged her cradle-like abdomen close to her body and only a fleeting glimpse of the youngsters could be obtained through the picket fence of flexible spines that guarded the edge of the cradle. The peculiar structure of this pouch epitomized one of the most remarkable chapters of evolution in the crustacea for it delineated the development from a long lost symmetrical ancestor of a degenerate asymmetrical creature, of supposed *Eupagurine* stock, who in adapting itself to changing conditions had assumed a protected, commensal existence and thus atrophied some of its organs, becoming lop-sided. Subsequently, in conforming to further changing conditions, which may have been due in part to its migration from littoral to deep-sea waters and to its resumption of a free unprotected existence, it reassumed some



Young of the Giant Sunfish. From a pen drawing by Don Dickerman from a specimen taken by the *Arcturus*.

The Staff of the *Arcturus* sorting the catch from a mass of Sargassum weed. A veritable argosy of forms of indescribable gracefulness, that were tantalizing fragments of stories of under-sea life.

of these lost characters and evolved other modifications which make it exceedingly interesting. The large size of these infants and their great numbers bespoke Nature's provision against the vicissitudes they must encounter in the icy depths. But when or how these small folk go out to seek an independent existence—or what series of forms, whether of ethereal, fairy-like grace or grotesque, luminous, hobgoblin shape, they achieve in the complex metamorphoses leading to the adult state, is unknown.

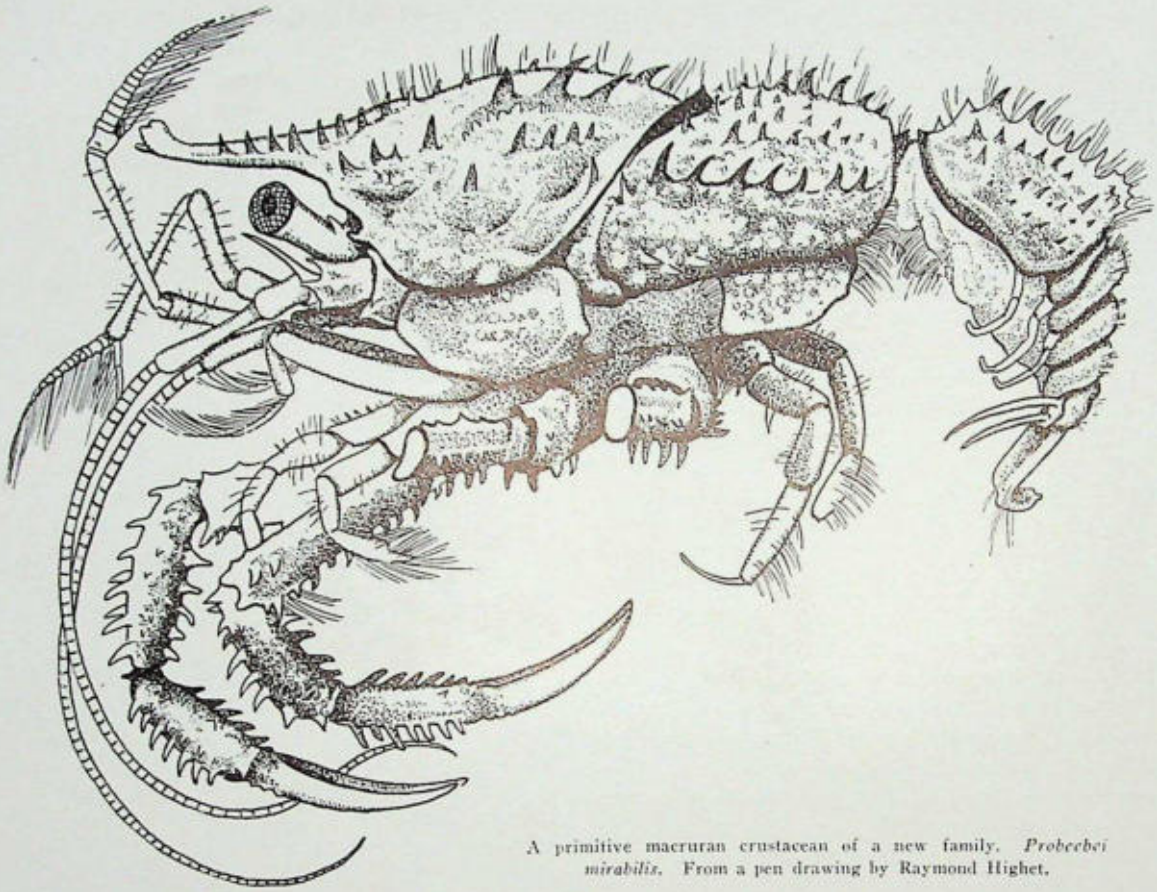
And finally we espied the most supremely interesting crustacean of the entire expedition (page 73), who with the unobtrusive modesty of the truly great, made no flaunting claim for attention, a shy, small creature which might well have been overlooked as one of the myriad amphipoda surrounding him. Yet a subtle prescience of immemorial mysteries proclaimed him to be The Missing Link. This is one of the most bromidic of phrases, and misused ninety-nine times out of a hundred, but in this particular case it is as well deserved as it can be when applied to any creature still living on the earth today. We looked, afraid to look—mutely questioning the unbelievable evidence. It was more inscrutable than the Sphinx, and in its characters, unquestionably aeons older. With fear lest our treasure vanish in the dispassionate light of scientific fact, we examined this exquisitely delineated ivory figurine.

Could it be an aberrant amphipod? Yes, suggested the side-plates and some of the appendages, but no, declared the stalked-eyes and macruran-like carapace. Could it be a macruran? But the carapace is composed of seven *articulated* plates, and the second abdominal segment has no counterpart in macruran forms. Vaguely, it calls to mind the anterior abdominal segments of a *Lithodid* crab. Is it a crab? Still more impossible.

Segment by segment we analyse the mystery, and tabulating the data, find that we have a primitive macruran crustacean, so aberrant from all known forms that a new family must be established for it. And so the "Missing Link" is christened: *Probeebei mirabilis* in honor of William Beebe, the Director of the Arcturus Expedition.

CHANGE OF ADDRESS

The mailing department is constantly receiving mail matter returned for lack of proper address. Members of the Society should send changes of address at once to insure safe delivery of publications or in any case a correct forwarding address.



A primitive macruran crustacean of a new family. *Probeebei mirabilis*. From a pen drawing by Raymond Highet.

A NEW FAMILY OF CRUSTACEA

Preliminary Technical Description

By LEE BOONE

Family: PROBEEBEIDAE.

Rostrum well developed. Carapace consisting of seven articulated segments. First legs equal, strong, chelate. Outer antennae with scapocerite; flagellum very long. Second antennae long, multiarticulate, biflagellate. Second abdominal segment arched, armoured as the carapace. Rhipidura flexible. Telson transversely divided, distal section reflexed rigidly upon proximal half.

Genus: *Probeebei*, with characters of family. Only genus known. Type: *Probeebei mirabilis* new species.

Probeebei mirabilis, sp. nov.

Rostrum half as long as carapace, upturned. Carapace consisting of seven articulated plates. Eyes prominent. First abdominal segment hingelike, second very prominent, arched. Rostrum, carapace and first two abdominal segments ornamented with rows of prominent spines; third to sixth segments inclusive smooth, subcylindrical, deflected; second, third and fourth segments with degenerate uniramous pleopoda attached at outer lateral margin, resembling side plates. Rhipidura slender, sublunate, outer blade larger. Telson small, transversely segmented apical part rigidly deflected upon proximal half, tip hooklike, upturned. First legs chelate symmetrical, second and third broken, basal parts are replica of first pair. Third and fourth legs weak. Mouthparts unique.

OBJECTS AND ACCOMPLISHMENTS OF THE ARCTURUS EXPEDITION

By WILLIAM BEEBE

I AM frequently asked for a brief résumé of the objects and the accomplishments of the Arcturus Epedition and to satisfy this curiosity I offer the following paragraphs.

The avowed objects were the investigation of the Sargasso Sea and the Humboldt Current. Owing to continual storms the former was in

such a disintegrated condition that I soon decided to postpone detailed study until a more favorable time. In the Pacific, to our surprise, we found that there was absolutely no trace of the Humboldt Current about the Galápagos. The abnormal absence of this great, cold, Antarctic current proved eventually of much more interest than its presence could possibly have been.

Among the totally unexpected and inestimably valuable phenomena—the high lights of the expedition—were the following, treated in my forthcoming volume in the chapters indicated: The great volcanic eruption on Albemarle (Chapter V); the albatross rookery on Hood Island (Chapter IV); the remarkable results of hundreds of dives in a copper helmet and bathing suit (Chapters III, VII, IX, XI and XII); the discovery in New York of a dramatic personage who had sought pirate treasure on Cocos for two decades (Chapter X); a current rip in mid-Pacific which drew to itself vast numbers of invertebrates and fish of all kinds (Chapter II); and the deep sea work in the submerged Hudson Gorge, only one hundred miles from New York City (Chapter XV). Finally, the accomplishment which, scientifically, proved most interesting of all, was the result of my decision to make a ten-day stay in one spot in mid-ocean, Station 74, (Chapters XIII and XIV), where continual dredging yielded very remarkable collections of fish and crustacea, equivalent to any two months of the less intensive work. In fact the crustacea taken at Station 74 equal 80% of all the rest taken in the Pacific on this expedition.

PROPOSED SUMMER'S WORK OF THE TROPICAL RESEARCH DEPARTMENT

By William Beebe

WHILE several months' work are still necessary to complete the study of the marine specimens taken on the *Arcturus*, yet it is hoped that this summer, a beginning can be made of investigating the mid-water and bottom life of the sunken Hudson Gorge. As this is hardly more than one hundred miles from City Hall, New York City, the results would be of unusual local interest.

It seems to be generally believed that to obtain the strange inhabitants of the ocean depths it is always necessary to go to far distant regions, but the results of *Arcturus* Station 113, last July, showed that, close to our city, there live some of the most remarkable of the sea-devils and luminescent fishes. If we draw a circle about New York City which will include Poughkeepsie, Reading, Southampton and Atlantic City, we may be certain that within the southeast periphery there are living and swimming at this moment fish which, in astonishing form of body, development of light organs and exaggerated mouths and fins, are the equal of those taken thousands of miles away.

We have lists of the birds and reptiles and surface fishes to be found within a hundred miles of New York. A list of the deep sea life, with all its chances of absolutely new discoveries, is a worthy goal for the Tropical Research Department of the Zoological Society. If a collection of such creatures can be made by the members of my department, exhibited at the Aquarium and the Oceanographic Hall of the American Museum, and the results of their study published by the Zoological Society, a wholly new field of research will have been tapped at our very doors.

In addition to all this, opportunities are focussing for an excellent chance this summer, of proving whether a human being can descend to much greater depths than have heretofore been thought possible, and make observations, protected in an all-steel cylinder, manufacturing his own oxygen.

RAYMOND HIGHET

A New Artist in the Department of Tropical Research

By William Beebe

THIS department announces with pleasure that a new artist has become associated with its work. This is Mr. Raymond Highet, who will occupy the position of Technical Artist. He has been Art Director of a number of large organizations which produce art work, and has done much advertising and magazine illustrating. His technique is remarkably sure not only in fine pen and ink detail, but also in oils, water-colors and pastels, and he can also do etching and lithographing. Most valuable of all to the Zoological Society is his enthusiasm for scientific work. His first drawing for the Department, on page 73 in the present Bulletin, indicates his flair for delicate and accurate delineation.

FOUR KING PENGUINS

FOUR king penguins, (*Aptenodytes patachonicus*), the first to reach America alive, were received at the Zoological Park on March 29th, 1926. A section at the southern end of the Cape fur seals' pool, near the Reptile House, has been devoted to their use, and here it is hoped that they will be able to survive New York's tropical summer.

Very few king penguins have been exhibited alive in Europe. As far as I am aware, the largest single importation was made by the late Carl Hagenbeck, in 1912. When I saw these birds at Stellingen, Germany, in December of that year, the flock numbered about twenty. They made an impressive exhibit, in a pool surrounded by imitation ice, which they shared with a walrus! In spite of their apparently excellent condition, none of these birds survived for long.

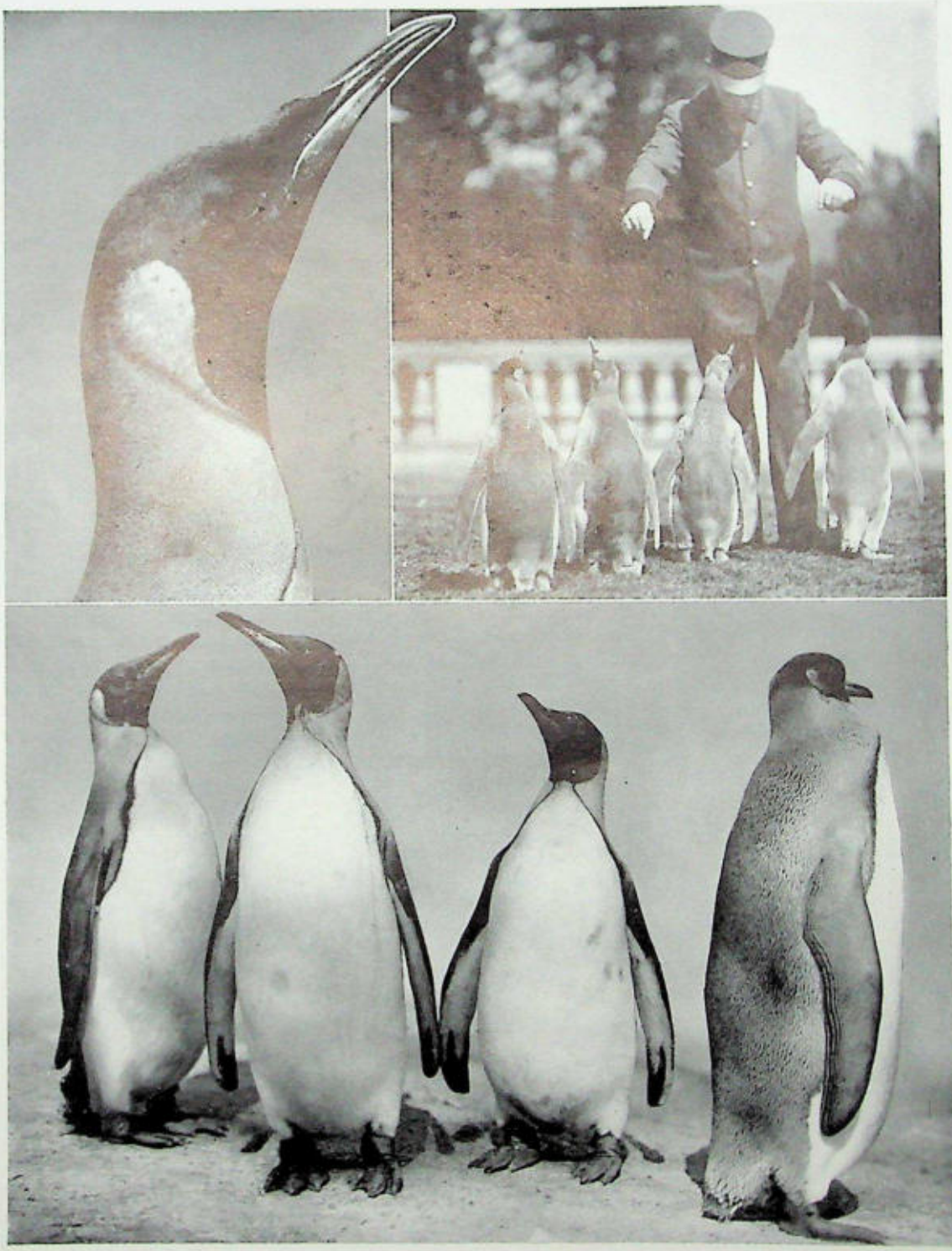
Little authentic information concerning the longevity and habits of the king penguin in captivity, is available, and this is of conflicting nature. Writing in 1911, Dr. P. Chalmers Mitchell states that up to that time, nine king penguins had been received at the Zoological Gardens of London. The hardiest of these birds lived eleven months, while the average endurance was but three and six-tenths months. On the other hand, the Zoological Gardens of Edinburgh, Scotland, have established a thriving colony of kings, and have even succeeded in inducing them to breed. It seems probable that, with these birds, the factor of climate is a very important one.

Our birds are said to have been captured on South Georgia, an island lying in the south Atlantic Ocean, approximately a thousand miles east of Cape Horn, and much used as a whaling station. The king penguin is also found in the Straits of Magellan, the Falkland Islands, Kergulen Island and various small and cheerless islets of the subantarctic ocean, south of New Zealand.

Second in size only to its great relative, the emperor penguin, the king penguin stands close to three feet high, when fully erect. It is beautifully colored, its back being a slaty blue and its breast white. The head is black and there are patches of brilliant orange about the neck and throat.

The breeding habits of the king penguin are most peculiar. No nest is built, and the single white egg is held on the parent's feet, covered by a soft fold of the abdominal skin. The parents alternate in this duty, passing the egg from one to the other with the greatest care, lest the egg become chilled. The newly hatched chick is brooded in the same manner, until it is large enough to be safe from the cold.

The penguins find their food in the sea and their wings have become adapted for use as oars, much like the flippers of seals. On land, they are clumsy and awkward, walking upright, with a slow, dignified gait that is suggestively human. They are practically without fear of man, and this trait, combined with their slowness of pace, has led to their slaughter in great numbers in many localities.



King Penguins in the Zoological Park. The penguin is web-footed and flightless and is essentially a sea bird, seldom coming on land except at the breeding period. The flipper-like wings are placed far behind, and the feet are plantigrade adapted to hold the body in an erect position. The wings are characterized by the absence of quills, and the whole body is covered with a plumage of scale-like feathers. Though stupid and helpless on land, they are superb swimmers, actually flying through the water using their wings as fins and breasting with ease the most violent seas. Their food is chiefly fishes and crustaceans.

THE BURROUGHS MEDAL

Burroughs Memorial Association Medal Presented to an Officer of the New York Zoological Society

ON April third, in the auditorium of the American Museum, William Beebe was awarded the first bronze medal of the John Burroughs Memorial Association. The Introduction was by the Hon. Theodore Roosevelt, and the Presentation by the President of the Association, Mr. Clyde Fisher.

This is the first time the medal has been given, and hereafter it will be presented annually "for the best literary work in the field that was so eminently occupied during his life by John Burroughs."—*E. R. S.*

THE HIGH LIGHTS OF GEOGRAPHY: (VOL. 2) EUROPE

By DAVID STARR JORDAN *and* KATHERINE DUNLAP CATHER

AN adorable book, beautifully illustrated, that makes one feel how fortunate are the children of to-day. It will prove pleasant reading at home and delightful for reference abroad, for it should be in the trunk of every child going to visit Europe.

The opportunity for legend and folk lore is handsomely taken advantage of, yet fact and fiction are so tactfully differentiated that a child is not asked to renounce his instinctive love of the mythical for the truths of history. He learns to distinguish clearly between the two and to appraise scientific facts at their true value. He is expected to take nothing on faith. He sees for himself that truth is not only stranger than fiction, but quite as beautiful.

In no better way could any child acquire a broad and sensible view of the earth on which he lives than through this wonderfully able work of Dr. Jordan and Mrs. Cather. The ideas of the slow passage of incalculable ages of time; of biological beginnings upon earth; the action of glacier, volcano, sea and river in effecting the ever-changing landscapes throughout the ages; the early days of the human race; the principle of "live and let live" as applied to field and forest and the wild life that inhabits them; the geological meaning of the natural wonders of Europe; all are conveyed in clear and gripping sentences. And the carefully chosen English, elegant in its simplicity, in itself makes the book a rare companion. Published by the World Book Company.

STUDYING NATURE'S BOOK

WHILE palæontologists are studying fossil remains of animals that walked the earth ago, zoologists are discovering new species and drawing new lessons from those that are alive to-day. William Beebe's exploration of depths in the ocean off the Galapagos Islands has brought to notice strange creatures such as fish that illuminate their own paths in the dark waters with headlights, like an automobile finding its road in the night, and use tail lights perhaps to prevent collisions.

A Record Flight.—One swallow, winging southward for the winter, kept right on going until it reached cold weather again. A bird, captured here [Cape Town, South Africa] had on its leg a ring which had been attached by an ornithologist in Northumberland county, England—6,000 miles away.

TWO DRAMATIC SECRETS RECENTLY GIVEN UP BY THE SEA

By WILLIAM BEEBE

NEVER have the powers of man's imagination shown up as so pitifully inadequate when compared with the truth, as in the case of the life in the deep sea. Unable to descend himself, he has pictured it as full of seemingly impossible beings, with the climax of a sea-serpent, of any size and length which may come into his head. However, every figment of his mind has been outdone, every artificial beast has been outdragoned by the results of the deep sea hauls of the *Arcturus* and of all the preceding oceanographic expeditions. And added to this, new and unexpected discoveries have been made, so astounding that man's fairy tales have become commonplace in comparison.

Let us briefly pass two in review—the life history of the common eel, and the unbelievable story of the parasitic male sea-devils.

Among the hosts of creatures which we took in quarts of plankton in our surface nets by day and by night in the Sargasso Sea was *Leptocephalus*. This same *Leptocephalus* is a general, ignorance-confessing name given to the larval form of eels. My first introduction to one was when I looked at a small aquarium of plankton and saw a half-dozen mother-of-pearl

One of the hosts of forms taken in the surface nets of the *Arcturus* in the Sargasso Sea. It is *Leptocephalus*, an ignorance-confessing name given the larval form of the common eel.

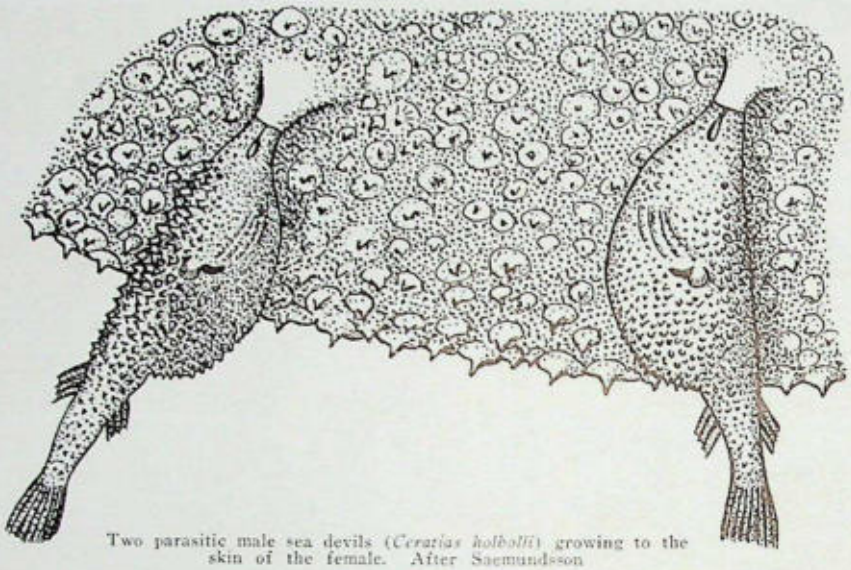
eyes swimming around quite by themselves. This was after I had been studying plankton for a few dozen hauls, and had passed the stage of wondering whether excess of microscopic work was working injury to my eyesight. Yet even now I did not quite believe what I saw, until I dipped in my hand and lifted out a twelve-inch piece of flexible water. There was absolutely no structure to be seen except the gleaming eyes, and yet here was a living fish. When dead and preserved, the body, shaped like a long, thin willow leaf, became translucent, and then it was possible to make out the hundred-odd delicate segments and the all but invisible gills and stomach. When the head was placed under the microscope there leaped into view a regular old-fashioned dragon, with enormously long, sabre teeth, which, were the animal twelve feet instead of twelve inches in length, would make it infinitely more dangerous than the largest anaconda. In the Sargasso Sea we took hundreds of specimens of many species, only a very few of which can be accurately identified, for the reason that we lack the connecting stages between these indefinite water wafers of organism and the more palpable adult fish.

The history of two forms of *Leptocephalus* has only very recently been worked out, and is one of those inexplicable complexities of nature, which to our practical, human minds seem an absolute waste of energy. To Dr. Johs. Schmidt belongs much of the credit for the patient unravelling of this astounding problem.

Briefly, these watery beings which, at night, we captured in dozens in our surface nets, are hatched from eggs which are deposited not far south from my first Sargasso objective,—30° North and 60° West. At least two species of these tiny, newborn *Leptocephali* soon begin to swim northward, reaching the latitude of Bermuda within the first year. They then separate into two mighty streams. The one which swings westward develops rather rapidly and soon after the first year has changed into young eels or elvers, and, guided by some instinct to which we have not the slightest clue, seeks the various fresh-water streams and rivers from Florida to Canada, from which, a year or more before, their parent eels emerged.

The offspring of European eels, on the contrary, turn to the east and then take three years to reach the mouths of their ancestral rivers—be they British, Spanish, German or Norwegian. Here they wriggle slowly up the saltless currents, and after a dozen years or so, play their part in this marvellously intricate round of life. In a single haul of a meter-net at 30° North and 60° West it is possible that we captured two *Leptocephali*, one of which would have completed its growth in the farthest tributary of Lake Ontario, and the other in some little stream of the head waters of the Rhine.

Why should such sedentary creatures, spending almost all their lives in a single reach of brook or stream, suddenly be moved to traverse thousands of miles of open ocean, braving voracious fish and cetaceans, to lay their eggs in the Sargasso Sea close to an alien continent, when others of their class successfully spawn under the nearest pebble? Is there a more dramatic phenomenon in the world than a whole generation of adult eels of two continents moving majestically in their millions,—setting out upon a voyage at the end of which each female will scatter her ten million or more eggs, and from which adventure no eel will ever return! When, within a space of several

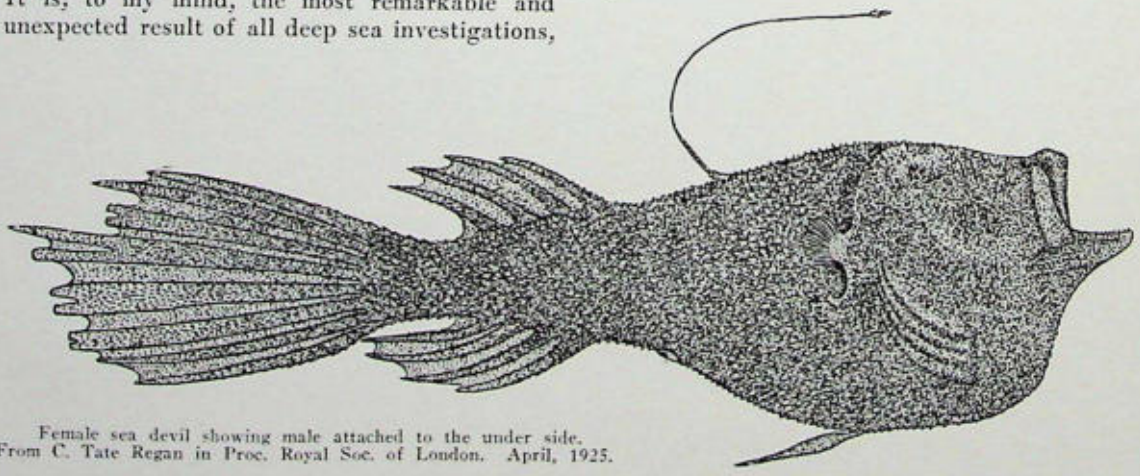


Two parasitic male sea devils (*Ceratias holbolli*) growing to the skin of the female. After Saemundsson

years, learned ichthyologists wrote confidently of eels discending to salt water and, inside of a month, depositing their eggs close to shore, we can hardly afford to laugh at Aristotle who, two score centuries ago, stated that eels have no sexes, nor eggs, nor semen, and that they rise from the entrails of the sea.

Another discovery was published only a week before the *Arcturus* started on her expedition. It is, to my mind, the most remarkable and unexpected result of all deep sea investigations, and reveals a condition existing in back-boned animals, which is comparable only with such lowly organisms as certain crustaceans and worms. Three genera of the abyssmal sea-devils, closely related to the species which I have named in this BULLETIN, have been found in which a diminutive adult male fish is actually growing from the side or head or behind the gill of the much larger female—a parasite in every sense. So complete is the association, that the male derives all nourishment through the blood supply of the female, and hence has lost teeth, and the luminescent lure, while eyesight and the alimentary canal have degenerated to the vanishing point.

Stimulated by this news, I scrutinized every specimen of these little sea-devils which we captured, but was not fortunate enough to find such an association. When, from this astounding example, we realize the possibilities of deep sea life still unknown to us, every haul of the dredge should be welcomed by an expectant enthusiasm, equalled in other fields only by the possible hope of communication with our sister planets.



Female sea devil showing male attached to the under side. From C. Tate Regan in Proc. Royal Soc. of London. April, 1925.

A new ceratioid fish. The little sea devil of the *Arcturus*. From a drawing by Dwight Franklin.

A NEW CERATIOID FISH

Preliminary Description of a New Genus and Species

By William Beebe

OWING to especial mention in my forthcoming book, "The Arcturus Adventure," of this new genus and species of Ceratoid fish I have thought it worth while to name it now and present preliminary description. This will, of course, be followed in Zoologica by a complete diagnosis in connection with all the Arcturus Pediculati.

Diabolidium arcturi gen. et sp. nov.

Differs from *Linophryne* in possessing a quadrilateral head; a wholly different cephalic spine, long, jointed and partly procumbent with an elaborate, luminescent tip, candle-like in appearance; two pairs of maxillary spines; an exceedingly long, undivided gular tentacle; fewer teeth in the jaw (16 in the upper and 12 in the lower), and fewer caudal rays (6 rays). Fin formula: 1st D1; 2d D3; A3; P15; C6.

One specimen obtained, 40 mm. in length, taken in the Pacific Ocean, 4° 50′ N, 87° 00′ W, at Station Seventy-four on the Arcturus Expedition, in a net drawn at 500 fathoms depth. The fish lived for ten minutes, long enough for the artist to sketch the outline and all the general characters. It then collapsed and altered materially in form. The white base of the candle-like organ and all the longer teeth showed distinct luminescence in the dark room during the first three minutes after capture.

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ZOOLOGICAL SOCIETY BULLETIN
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The Ocellated Argus Pheasant, *Rheinardius nigrescens*. From a painting by G. E. Lodge, published in the fourth volume of "A Monograph of the Pheasants."

A scene on the Pahang River near Port Swettenham. Junks with sails like wings of giant butterflies, and sampans ply along the coast of Pahang.

and permanence, was fraught with a deep sense of unreality. Within a month this entire valley was to be dammed and filled to the brim with reservoir water, and all these lakes and drives, the arbors-and elaborate flower-beds, the palms with their birds' nests, and the myriads of other contented homes, would be buried many yards deep in cool, fresh water.

The only observation which remains in my memory was strange enough to be significant of the abnormal fate of these beautiful gardens. I saw a young duckling killed and partly pulled under, and when I looked carefully into the troubled waters I was astonished to see that the bird had been slain by an insect, one of those great water-bugs which in the States are

A glimpse of the Bukits or isolated outlying foothills of the great Malay mountain range, the backbone of the finger peninsula, which stretches southward from Siam to within sight of the Bund of Singapore. Designated by the Malays as "the walls of the world, shutting out the winds and beasts of prey."

commonly known as "electric-light" or "kissing" bugs. The powerful insect had submarined up and driven its beak deep into the breast of the duckling, which had died after a few futile struggles.

Late in the evening I walked through the native quarter of the town of Kwala Lumpur. Then for the first time I began to appreciate how completely the Chinese are elbowing the Malays to the wall. The latter are excellent syces and grooms, but in all other capacities one thinks only of Mongolians.

Even at this late hour one tiny photographer's shop was open, with the proprietor, a short but clean-limbed young Chinaboy, squatted just within. His eyes were narrowest of slits, his pipe with its microscopic bowl was held lightly between his teeth. He might have been fast asleep. But as the first indication of my hesitancy, of my prospective interest, Chinaboy rose swiftly, his pipe vanished, and his eyes opened to ovals. Smilingly I was wished "Goodleevling."

In days to come Chinaboy did work for me, and did it well, and I was the richer for knowing him, for watching his quiet assurance, his unassuming dignity. But best of all was his story, which was narrated with insight and imagination by the wife of a government official. It is a tale which is duplicated daily, perhaps hourly, wherever Malay and Chinese come into contact—a tale of the quiet surpation, by thrift and steadiness of purpose, of almost every field of endeavor by these patient Mongolians.

Thus the steady, quiet, unyielding conquest of Malaysia is being carried forward by Chinaboys—first immigrants, later apprentices, and at last proprietors. They come from an overcrowded, impoverished land which only reluctantly yields its increase. They are trained to industry, tenacity, and thrift. Before their attack the good-natured, slow-moving, indolent Malay goes down to quiet, certain defeat.

Three hours of intensive effort the next morning set various people and official departments in motion, perfecting arrangements for the trip into the interior. When I had given it sufficient impetus, I turned the matter over to competent hands, Aladdin's and others, and made my way as speedily as I could to the nearest jungle. I could hope only for a short plunge to-day, and on the advice of a bronzed planter, whose love of the wilderness shone in his eyes when I told of my coming trip, I motored out to a bukit, or mountain, in which were some interesting limestone caves.

A stiff climb of a hundred yards brought me to the mouth of the dark cave—a great, gaping, black hole, the edges draped with graceful vines. I entered and, after going a hundred feet, looked back and saw an exquisite bit of the tropical landscape: palms, distant blue mountains, and white clouds framed in the jet-black jagged aperture.

The great height was overwhelming; the graceful dome-like summit of the cavern stretched up and up into the very vitals of the mountain. Then I plunged into darkness and lighted my electric searchlight, which seemed at first the merest bit of light ray. On and on I went, and at last, far in the distance, perceived a faint glimmer from high overhead. A rustling sound at my feet drew my light downward, and there untold thousands of great brown cockroaches, all striving to bury themselves out of sight in the soft, sawdust-like flooring, the century-old guano of the bats. I had to go with great care, for huge jagged rocks and deformed stalagmites obstructed the path in every direction.

From the black gulf ahead came, now and then, low distant mumblings, mangled with the shrill squeaks of the bats, and into this vocal void I now plunged, with the searchlight playing at my feet to avoid tripping and falling. I found that I had entered a veritable Dante's Inferno, and pictured to myself some still more dreadful "round" as presently to open out ahead. The sighing, gibbering, squeaking spirits or devils were there in multitudes, brushing my face or fighting among themselves as they clung to the slippery fissures high, high overhead. More than once my light led me down a small, blind side lane, into which I stumbled as far as possible. At the end of one such corridor was a roundish hole leading irregularly downward, far beyond the rays of my light. Another contracted very slowly, until the damp walls touched my head and sides and I drew nervously back, glad to escape from the sense of suffocation—as if the walls were actually closing about me, inevitably, irrevocably.

Farther on I turned sharp corners and wound my path around strange angles, disturbing unending hosts of bats and finding many recently dead, together with innumerable skeletons half buried in the guano. Now and then a centipede fled from my tiny pencil of light, and once I broke into a nest of stinging ants, blind but ferocious, which attacked me and made me flee for several yards headlong, heedless of bruising, jagged obstacles.

Gulliver, Alice and Soumas would not have been bored at these great caverns. A towering cliff loomed high overhead, clothed in green; the mouth a great, gaping black hole, the edges draped with graceful vines, and the lofty, dome-like summit of the cavern stretched up and up into the very vitals of the mountain.

From Kwala Lumpur to Kwala Kubu is only a few miles by an energetic little railway, which lurches and pitches sideways, but in spite of this never ceases to advance. The time passed quickly, as I chugged and jerked over the rails the next day, for I had two antithetical diversions. I could look out of the window and instantly yield to the hypnotic spell of the revolving wheel of the rubber trees, rendered more pastel and potent by the intervening mist of driving rain. Or, consulting my bethumbed handbook of Malay, I could mumble, "Buleh kasi habis kasut itu?" One sentence I omitted, making no effort to learn: "Pergi ka pasar beli buah durian satu biji," which, being translated is, "Go to the market and buy me a durian!"

In the dak-bungalow at Kwala Kubu, the Chinaboy chowkidar, queue in pocket, shod in shoes of silent felt, served my breakfast. I was at last on the threshold of a strange expedition in a land to which a letter rarely came correctly addressed, so unknown was it to the outside world. At this moment the strangest thing in sight was my breakfast. It consisted chiefly of tins of tiny Mongolian finches,—hummingbirds in size, squabs in taste,—canned a dozen to a tin.

At this moment, across the high range, there wandered slowly through the jungle pheasants, a giant ocellated argus—pheasants never yet seen alive by a white man. I knew that somewhere in that great unexplored tumble of mountains they lived, and it was to find them and their kindred that I have come half round the world. But now I had no time to think of them or of possible means of discovering them, for Aladdin, super-servant, rushed up as fast as his newly donned Malay sarong skirt would permit, and breathlessly announced, "Sahib, lorry ready." So I had to don my pith topee and regretfully leave three squablets swimming in their butter sauce; for the motor-lorry was wheezing and spitting. And His Majesty's mail waits for no one.

Thus I made my ascent to the summit of the great mountain range, amid a continuous whirl of choking dust which quite obliterated the scenery. I might have imagined myself caught up in a cloud, as worthy biblical characters were wont to be, only I am sure they were spared the odor of burning oil and rubber, and their ears were not assailed with a syncopated obstruction in the brake mechanism which, before the end of the trip, vied with the efforts and effect of any brain-fever bird.

When we emerged from our cloud and excavated our eyes we found a wonderland, a little rose-covered dak cottage with an immaculately saronged Singhalese in attendance, and tiffin of curry and tea. This was Semangko Pass—the Darjeeling and the Simla of the Malay Peninsula.

Semangko Pass struck deep into memory as the most beautiful of the tropical mountains of the East where I strove to match my senses against those of the jungle pheasants. The dak was perched on a little flat saddle at the very crest of the ridge, at less than three thousand feet above the blue waters of the Indian Ocean. On all sides the sharp-toothed mountains rose still higher, steep but jungle-clad, cutting the sky into all sorts of irregular bits of glory.

The days were wonderful, and the alternations of sun and wind were as exciting as the discovery of the strange Malayan beasts and birds. The sun rose softly—no breeze moved cloud or leaf, and even the light came at first moderately, indirectly, reflected from the higher peaks, or heliographed from the mirror of a half-hidden, distant waterfall. In early afternoon—one never knew just when—the faintest of breezes sifted down and blurred the lacery of tree-fern shadows. The wind was cool and soon strengthened, and by night the air was surging violently through the gap, siphoned from the cold summits down to the hot, humid valleys.

Day after day one reawakened to the sense of tropical surroundings from a conviction of a northern autumn, with the wind full of swirling leaves and the fronds soughing with the same sad cadence as the needles of scented pines of the northland.

The first night I listened to this strange sound of wind in the eaves of the bungalow, and the moans of the engineer's fever-stricken little baby, brought here for relief from the hot coast. And then I slept, and was awakened by the distant, faint chorus of wah-was, the long-handed gibbons, a sound as thrilling, as full of age-hidden memory meaning as the morning chant of the red howlers in the South American jungles.

The liana-draped trunks and the majestic jungle trees were the finest in all the East, second only to those of Amazonia, but the tree-ferns were beyond words—tall, graceful, with great unfolding half-clenched fronds, swathed in wool of richest foxy-red. Here, in this maze of mountain jungle, through its autumnal days and its wild, tropic nights, lived two splendid races of birds. One was the bronze-tailed peacock pheasant, the other the giant ocellated

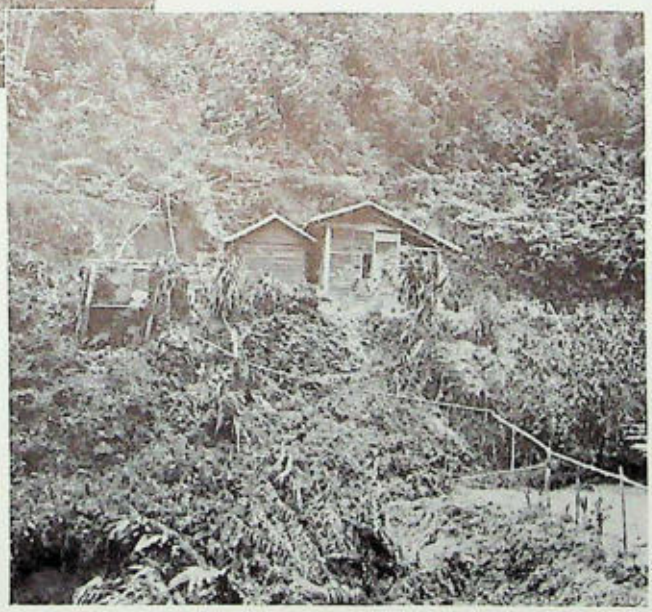
Semangko Pass, the Darjeeling and the Simla of the Malay Peninsula.

argus. Both were a challenge to my utmost effort. Neither had been seen by a white man; of neither had we any facts of home, courtship, food or foe.

So in khaki and moccasins, with gun and glasses and compass, I stepped into the filmy shadows of fern-fronds drooping high above my head, and essayed to awaken my senses from the dulling erosion with which hotels and formal dinners, railways and motors had overlaid them. Never have I encountered more worthy antagonists, and I was proud in the end to be able to record one victory and one drawn battle. I found the peacock, pheasants. The ocellated argus I heard and trapped, but the sight of a living bird awaits a better woodsman.

The Selangor side of the pass seemed to be pheasantless, so I worked chiefly to the east, in Pahang itself. I climbed the steep, upsloping jungle to an elevation of nearly forty-five hundred feet, creeping laboriously through bamboo tangles or holding on to long liana guy ropes, along precipitous, pathless banks. Sometimes the going was so heartbreakingly rough that I progressed only a mile in a half-day's tramp.

It was on one of these trips that I scored victory and saw the first bronze-tails. Late one afternoon I reached a steep land-slip which, a few months before, had carried away a wide swath of jungle, leaving the disintegrated rock exposed or decorated with the new-sprouted plumes of yellow-green bamboo. I had had a long, tiresome tramp, and was two miles from camp, across a deep, dark valley. At the edge of an open glade, sheltered by dense bamboos and close to the crest of a sharp ridge, I waited for an hour or longer—a lucky hour as it proved. After removing the usual unpleasant collection of leeches, sat quietly and watched the jungle life about me. A single tall tree leaned far out over the great earthen scar, its roots half exposed, soon to loosen and end its century of growth in an ignominous slide to the tangle far below.



A dak bungalow with bamboo water pipes near Semangko Pass. On all sides rose the sharp-toothed mountain peaks, steep and jungle clad.

From the topmost branches several bronzed drongos were flycatching and uttering their loud chattering song. A sudden whoof! whoof! of wings sounded close overhead and four heavy-pinioned hornbills alighted awkwardly, each striking its hollow anvil in turn, the air fairly ringing with the deep metallic sound. Then one of the birds discovered me, and the four swept off again with outstretched necks and a roar of wings.

Ten minutes later a tupaia, or tree-shrew, ran out along a dead bamboo stem and began to pull off the sheaths, poking his sharp nose under them, presumably after insects. A second ap-

peared and thereupon ensued a fight of the fiercest character. At first it was a pursuit, the two flying through the air. They closed at last on a branch and the fur flew from the mass of twisting limbs and bodies. Then over they went, separated in mid-air, and each stretched out his four legs to the fullest extent. Close to me they dropped, both landing on the great fronds of a tree-fern. They caught hold, rested panting a moment, and then vanished.

Hardly had they gone when a distant movement caught my eye and I looked intently along the ridge. There, in full view, were three bronze-tailed pheasants, apparently looking directly at me, although a screen of bamboo leaves

A typical Malay bungalow, with thatched roof. The roads were lined with these coolie huts and Chinese shops.

Malay Chief and his sons. The industry, tenacity and thrift of the Chinese is submerging the indolent Malay in certain defeat.

intervened. I soon saw that the sudden fall of the tupaias was what had attracted their attention. As I watched, two others appeared. They remained in sight about four minutes. One of the old birds never stirred from the spot on which I first caught sight of him,—head raised, alertly turning now this way, now that. The others moved about, stepping daintily and high. Two scratched for a while in the rain-washed gravel, one of them soon turning its attention to a clump of yellow flowers, picking the blossoms and swallowing them eagerly.

One of the adult birds stepped into a spot of full sunlight, the last which penetrated the foliage from the setting sun, and for a moment fluffed out every feather. The wings were lowered, the tail spread, and thus for a full minute did the splendid bird do homage to the last rays of the sun. The gray head and breast were alive with the tiny white spots which showed as living sparks in the sunlight. Each feather of the rich rufous upper plumage seemed consciously aglow through its individual eye, as if it could see itself reflected in the gorgeous mirrors of the tail. Their long tapering feathers were spread apart and their surfaces changed from green to violet, then to purple and black to emerald again as the angle shifted. I fairly held my breath for fear of putting an end to the rare display. At last the sun's rays died away, and simultaneously the bird's tail closed and hid the iridescent glory of the feathers. With low clucks the little covey walked slowly into a fern tangle. I hastened to the crest of the ridge, but neither saw nor heard anything more of the birds, though I could look far down into the damp, dark depths of the ravine, through a maze of bamboo columns and feathery fronds.

From a great distance came the base and treble of the wah-was, rising in wild, rollicking cadence. A fraying end of cloud-mist drifted

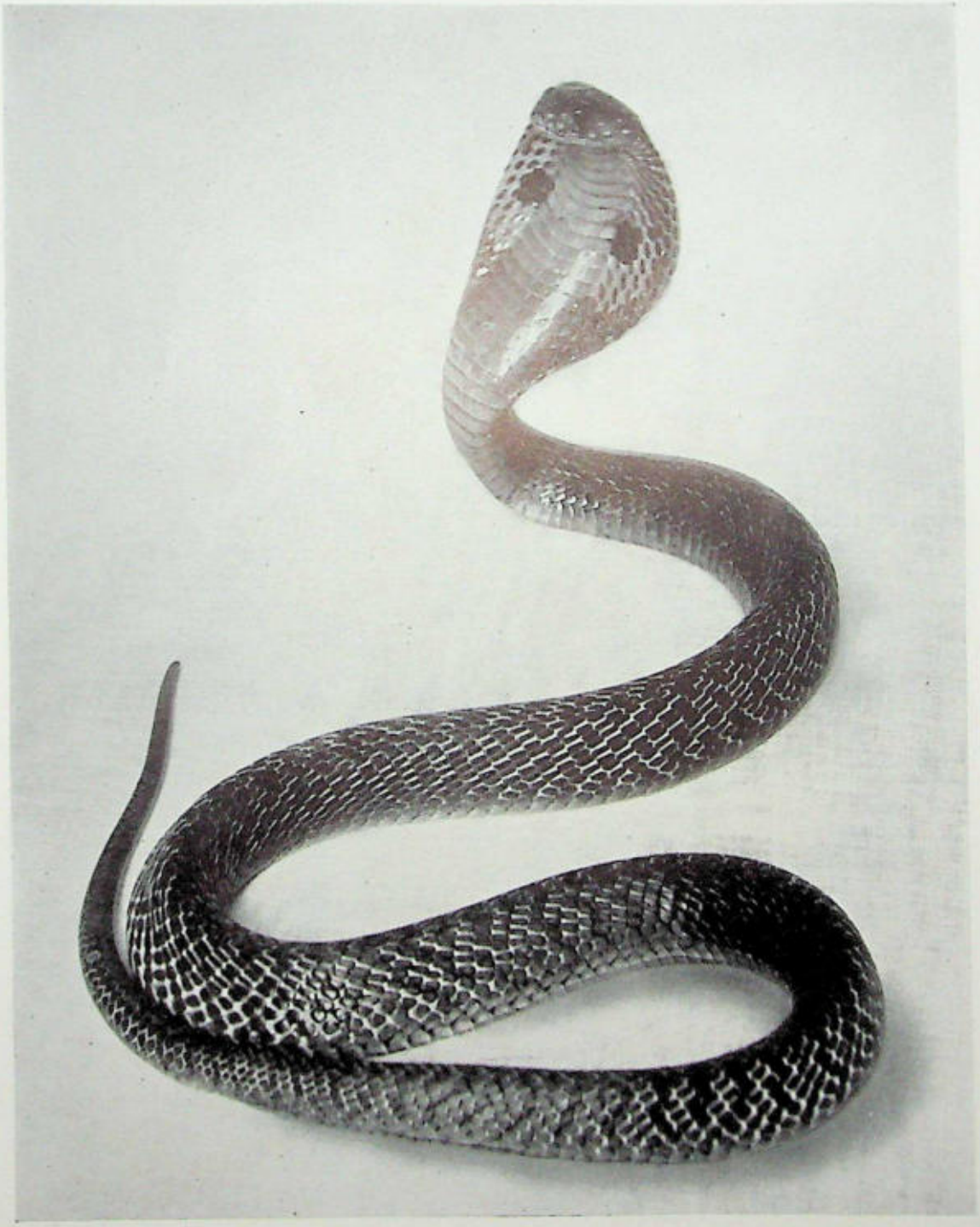
Continued on page 95

Some of the Flora in the Tropical Forests of Malaysia.

Giant buttressed tree in the Malay jungle. These majestic trees reared their tops to lofty heights firmly anchored by their gothic-arched roots.

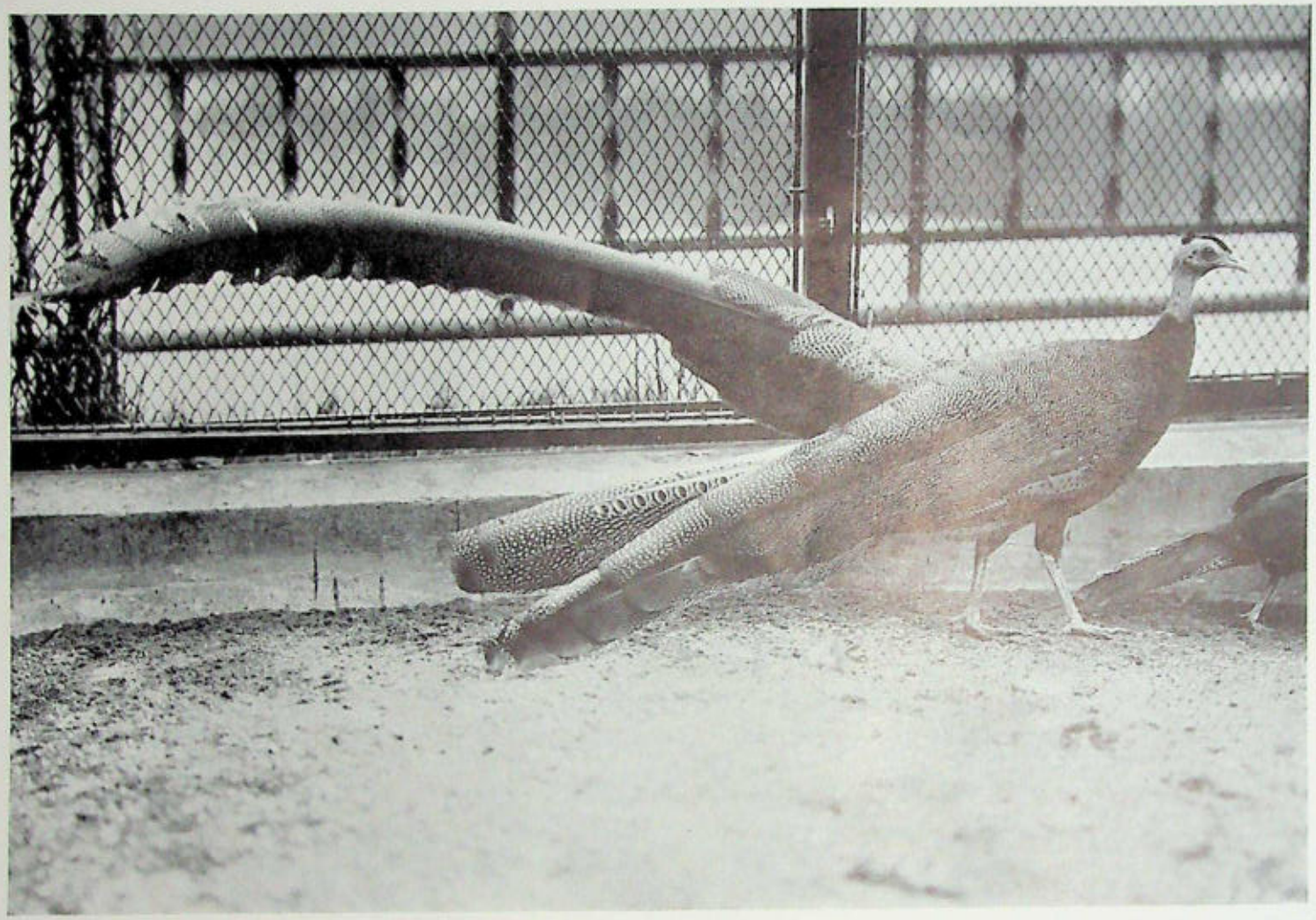
A delicate tracery of strange vines crept up the trunks of the trees, in fanciful mimicry of a waving line of birds in flight.

The White-handed Gibbon of the Malay Peninsula, as well as the other species of southern Asia and the adjacent islands, are distinguished from the greater man-like apes by their smaller size—frail, slender forms and length of arms. They are the only apes that walk erect seemingly by choice; a strange gliding movement, which they accomplish rather awkwardly, with a curious swaying movement, their long arms like those of a dancer waving not ungracefully. On the ground they are slow, but in the tree-tops their graceful movements dull by comparison the most difficult feats of the human acrobat; they literally fly swinging from bough to bough by their long thin arms. The genus—*Hylobates*—means "one who walks in the wood" from the Greek—hyle—wood, and baino—to go, and the specific name—*lar*—refers to the white hands of the Roman household God of the dead.



The Cobra-de-capello of Southern Asia, so named by the Portuguese, means "cobra of the hood." It belongs to the family Elapidae and is one of several species of venomous snakes distinguished by their power to expand the neck when excited. This is accomplished by thrusting forward a number of the anterior ribs, widening and flattening the neck below the head. When attacked it raises itself from the ground, dilates the neck and presents a most formidable appearance. Usually they are very courageous, and sometimes aggressive. The bite is exceedingly dangerous and generally fatal. The generic name *Naja* is from the Hindu-naj snake, and the specific name—*tripudians*—from the Latin for dancing because of the rather rhythmic sway of the body when erect.

The Loris of Southern Asia is a nocturnal animal related to the lemurs; sometimes called slow lemur because of their sluggish movements; as slow as those of the sloth. It is strictly arboreal, never leaving the tree tops where it lives; sleeping through the day rolled into a ball with its head thrust between its thighs and its hands clasping a limb. At dusk it begins its night-time rambles from which is derived the scientific name, the genus, *Nycticebus*—"night monkey"; *tardigradus* the specific name—meaning "slow walker."



The Argus pheasant of Malaysia derives its common name from the giant of Greek mythology who had eyes all over his body. The long secondary quills of the wings have beautiful eye spots like those of the tail of the peacock. The body is of the size of an ordinary domestic fowl, but the tail is sometimes nearly four feet in length. This picture is from a specimen in the Zoological Park.

past, warning me that a storm was brewing; and the shrill, metallic ring of the six o'clock bees marked the swift approach of dusk. I knew that the wild creatures of the night were waking all about me, from the tiny civets which would soon start out in search of mice and insects, to the black leopard, whose roar I had heard the night before and whose fresh track I would pass on the way to camp.

It is difficult to write of the great ocellated argus pheasant because of the indescribable marvel of itself and its life. Its myriad-eyed wing feathers, its complex courtship display, its secret dancing-ground in the heart of the jungle—all set it apart as a bird superlative and distinguished. In its great specialization of pattern and habit it has achieved a position perhaps furthest from its lizard-bird ancestry. Wary as it was, and much rarer than the giant gray argus, I made out to patch together a fairly satisfactory life-history from bits gleaned here and there—a deserted nest, a dancing-ground, a freshly trapped bird. Thrice my relations with it verged upon intimacy, when I just missed seeing it. And the very failure, the suspense never wholly to be lifted, impressed the details more vividly on my mind.

Once I watched—as always, alone—by a clearing which I supposed to belong to a gray argus; but after an hour, an ocellated argus pheasant approached, coming nearly within sight and then circling warily about. As I sat quietly amid the swaying stems of bamboos and the trembling fronds of tree-ferns, babblers in families, and small birds in loose flocks of several species occasionally passed, on their twittering, fly-catching paths of life. It was late afternoon and the creatures of the jungle were making the most of the last hours of daylight. Gaudily colored squirrels leaped overhead, and now and then a tree-shrew pushed his sharp muzzle around a neighboring trunk and stared at me, but unaccountably did not give the alarm. Close to me a bee-eater—lilac-fronted, flame-breasted—swooped after the dancing gnats. Long-tailed drongos were courting a small, unornamental female—three of them swooping about her at one time. As they flew and dipped and volplaned, the two round feather-racket tail-tips swept after them, apparently wholly unconnected by any physical bond. Two cock broadbills fought continually, with constant enthusiasm and equal discretion. In the rare intervals between their long-continued bouts both repaired to the upper air, high above the forest, for refreshment, and there soared about, for all the world like diminutive vultures, now and then dashing sideways after an insect. Small green parrakeets quartered the pheasant's clearing again and again, and a pair of giant, sombre-hued wookpeckers, bigger than ivory-bills, hammered vigorously, sending down chips upon the cleared arena.

All these voices and sounds seemed to show that there was no danger near; the usual life of the jungle was undisturbed; but the pheasant knew better. I had neglected some little precaution, and some stray strand of suspicious evidence had warned the bird that all was scarcely well. The woodpeckers might hammer and the drongos scream, but he was conscious of a something which drew a dead-line about his arena. He called, but half-heartedly, and after a reconnaissance he returned to some unknown covert. I could not let him know that I had no gun and that a half-hour's watch of his unconscious jungle life was all for which I hoped.

Another time only a transient physical disability prevented me from seeing one of these birds. An ocellated pheasant had been calling at dusk, and on my way back to camp I turned aside and followed a narrow game-trail to a stream. A loud rustle made me crouch low, but the animal, whatever it was, made its way off. I waited for five minutes and then the call of the great bird rang out directly behind me. So loud was it, I thought at first it came from overhead. Then a second time, and my ears rightly oriented it as a few yards behind. The light was failing. In a few minutes it would be dark, and I could hear the bird moving. I was hidden by a barrier of scrub. I attempted to leap to my feet and turned as I rose; but instead I merely fell awkwardly backward. Both of my feet were paralyzed, asleep, and would not support me. A second effort succeeded and I saw the swaying stems close together behind the fleeing bird, but never a glimpse even of a tail-feather.

My third experience was the most thrilling of all. Along the central Malayan range of mountains, on the Pahang side, rise innumerable little streams, mere rills at first, which soon gain in volume, rill added to rill, until a good-sized brook bubbles over the rocks and slides smoothly over fallen bamboo stems. Wading and splashing along these stream-beds is by far the most convenient means of exploring this region. Often the sides of the ravines are so precipitous that it is impossible to pass across or along them.

For two nights I had slung my hammock from the giant grasses beside one of these tiny

Pahang tributaries and had listened to a new sound. At frequent intervals, for a half-hour at a time, the loud call would ring out. It was almost the call of the great gray argus, but there was a strange intonation which attracted my attention at once. I realized at last that it was the evening call of the Malayan ocellated argus pheasant. While I never heard the calls of both species in the same evening, yet the difference was very marked. There was a muffled resonance about the cry of the ocellated bird which the cry of the other lacked; it sounded fully as loud, but was without that penetrating quality which carried the tones of the argus through fern and bamboo, over ravines and jungle slopes, to such great distances. It was more harmonious, less harsh.

Disregarding the rumors of tigers and black leopards, I crept through the jungle in the dead of night, the damp mist rising thickly from the reeking ground about me, and the white trunks of the jungle trees looming up like ghosts. I made my course by compass and broken lianas and laid it by the occasional wild scream of the bird. Finally I seemed to be approaching. Nearer and nearer sounded the call, appearing almost as if the bird were walking toward me. Then my electric search-light showed an impenetrable tangle of rotan and thorn-palms—a maze of myriad recurved hooks. Even in bright daylight one might not pass through this without laboriously cutting a trail, foot by foot.

So here I waited, crouched at the foot of a clump of lofty bamboos, my light shut off, and realizing as never before the mystery of a tropical jungle at night. A quarter of a mile away, the magnificent bird was calling at intervals, from just some such place as I was in. When my eyes recovered from the glare of the light, I found that the jungle was far from dark. The night was moonless and not a glimmer of star came through the thick foliage overhead. But a thousand shapes of twig and leaf shone dimly with the steady dull blue-green phosphorus glow of fox-fire.

Again the bird called, and I interpreted its message. The law of compensation! I was helpless to reach it, I was degenerate indeed in the activities of the primitive jungle-folk, but I thrilled at the mysteries of the nocturnal life. My pulse leaped at the wild call—not from a carnivore's desire for food, or from the startled terror of the lesser wilderness people, but because of the human-born thirst for knowledge, from the delights of the imagination which are for man alone.

Tree-ferns like giant candelabra line the mountain road in the great Malay backbone ridge.

New York Zoological Society

OBJECTS OF THE SOCIETY

A PUBLIC ZOOLOGICAL PARK. ¶ A PUBLIC AQUARIUM. ¶ THE PRESERVATION OF OUR NATIVE ANIMALS. ¶ THE PROMOTION OF ZOOLOGY.

ZOOLOGICAL SOCIETY BULLETIN

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Departments:

Mammals — WILLIAM T. HORNADAY
Aquarium — CHARLES H. TOWNSEND
Birds — LEE S. CRANDALL
Reptiles — RAYMOND L. DITMARS

WILLIAM BEEBE
Director, Tropical Research: Honorary Curator, Birds

Each author is responsible for the scientific accuracy and the proof reading of his contribution.

Members of the Zoological Society are entitled to all publications, Reports, Bulletins, Zoologica, etc., (Zoologica mailed by request only) and no effort will be spared to ensure their delivery. Changes of address, forwarding points and non-delivery of mail should be stated promptly. Contributions pertinent to the objects of the Bulletin cordially welcome. Stamped and return envelope should accompany communications. Address Editorial and Subscription Offices, Zoological Park, New York City. Elwin R. Sanborn, Editor.

VOL. XXIX MAY-JUNE, 1926 No. 3

OUR ENDOWMENT FUND

An unexpected and very splendid bequest of $1,000,000 has come to the Society by the will of the late Anna M. Harkness, which sum will be applied to the General Endowment Fund when received. No unusual delay is anticipated in the payment of this bequest.

Mr. John D. Rockefeller, Jr., has construed the bequest of Mrs. Harkness as a compliance with the terms of his letter of June 25, 1923, making a gift of $500,000 to the Society and promising an additional sum in a like amount when the Society had obtained other gifts amounting to $1,000,000. He has paid in $500,000 to the Treasury of the Society, which sum has been added to the Rockefeller Endowment Fund, making the total of that fund $1,000,000.

On March 8, 1926, the Society received an additional contribution to its General Endowment Fund from Mr. Edwin Gould in the amount of $15,000.

Mr. Coleman du Pont has very generously paid in the whole of his conditional gift of $25,000.

THE JACOB H. SCHIFF FUND

Mr. Mortimer L. Schiff has presented $25,000 to a special endowment fund to be known as the Jacob H. Schiff Endowment Fund, to which new fund will be transferred from the General Endowment Fund the original subscription of $25,000 of the late Jacob H. Schiff. This original subscription was the nucleus or foundation stone of the present General Endowment Fund.

DR. HORNADAY RETIRES

Dr. W. Reid Blair Appointed Director

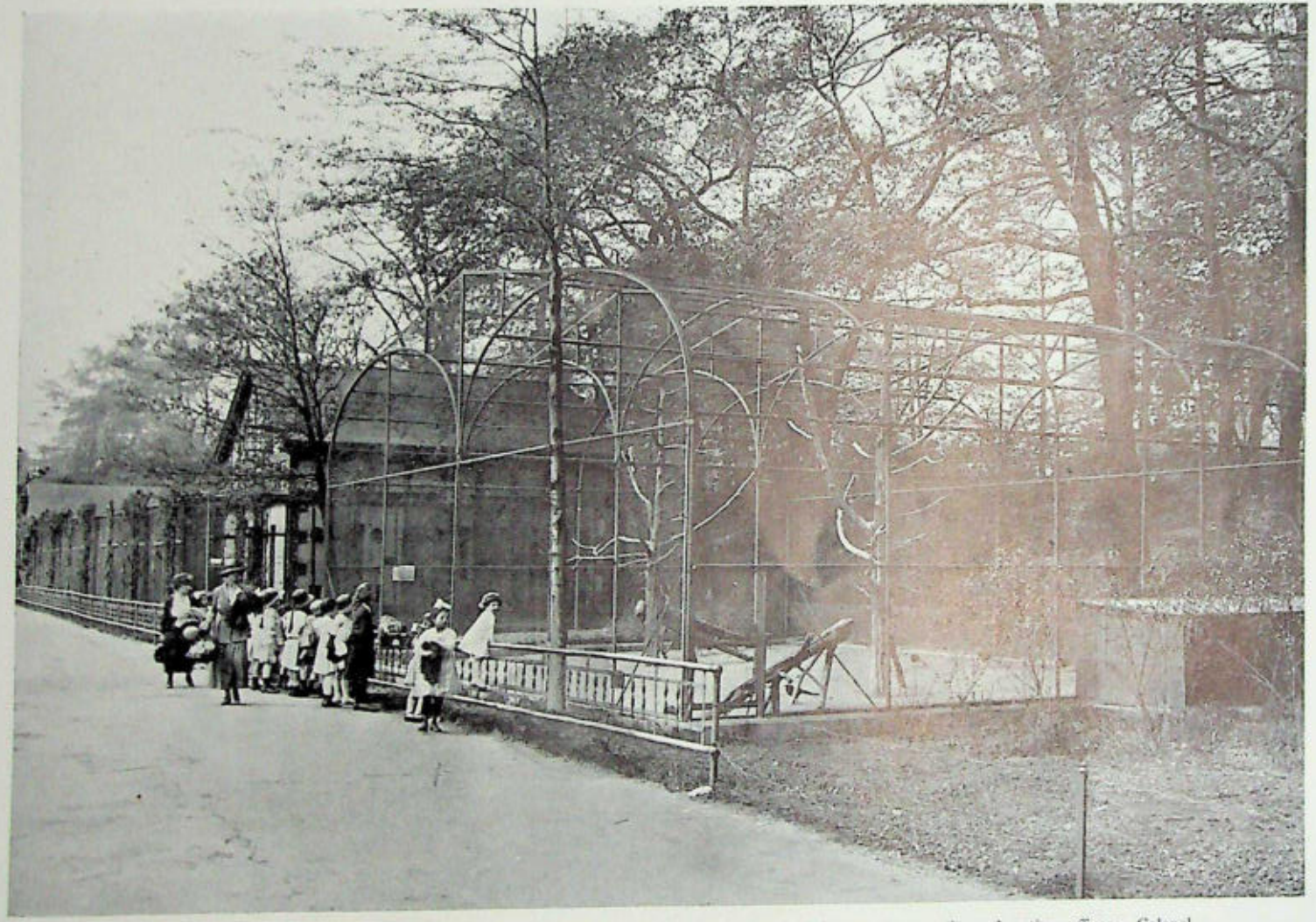
Dr. William T. Hornaday, for thirty years director of the Bronx Zoological Park, announced his retirement from office at the annual Garden Party of the Zoological Society, May 20, 1926. His successor will be Dr. W. Reid Blair, Assistant Director since 1922.

Officers and friends of the Zoological Society arriving for the annual garden party at the Administration Building in Bronx Park in the afternoon had their day spoiled by the sudden announcement of Dr. Hornaday's retirement.

The officers of the Zoological Society paid tribute to Dr. Hornaday in the following resolution:

"Chosen in 1896 as the best qualified expert in the United States in zoological park planning and administration, Dr. Hornaday studied all the great zoological parks of Europe, discovered the peculiar fitness of the South Bronx Park, transformed the meadow land and wild forest, and submitted the first general plan in accord with the three great principles previously established by the Society, a free park, encouragement of interest in animal life among all classes of people, and preservation of the native animals of North America."

Dr. W. Reid Blair, the new Director, is a native of Philadelphia, a graduate of McGill University Medical and Veterinary Schools, and, since his graduation, a member of the Scientific Staff of the Zoological Park, specializing in the study of the diseases of animals in captivity. During the World War he was Chief Veterinarian of the Fourth Army Corps of France.

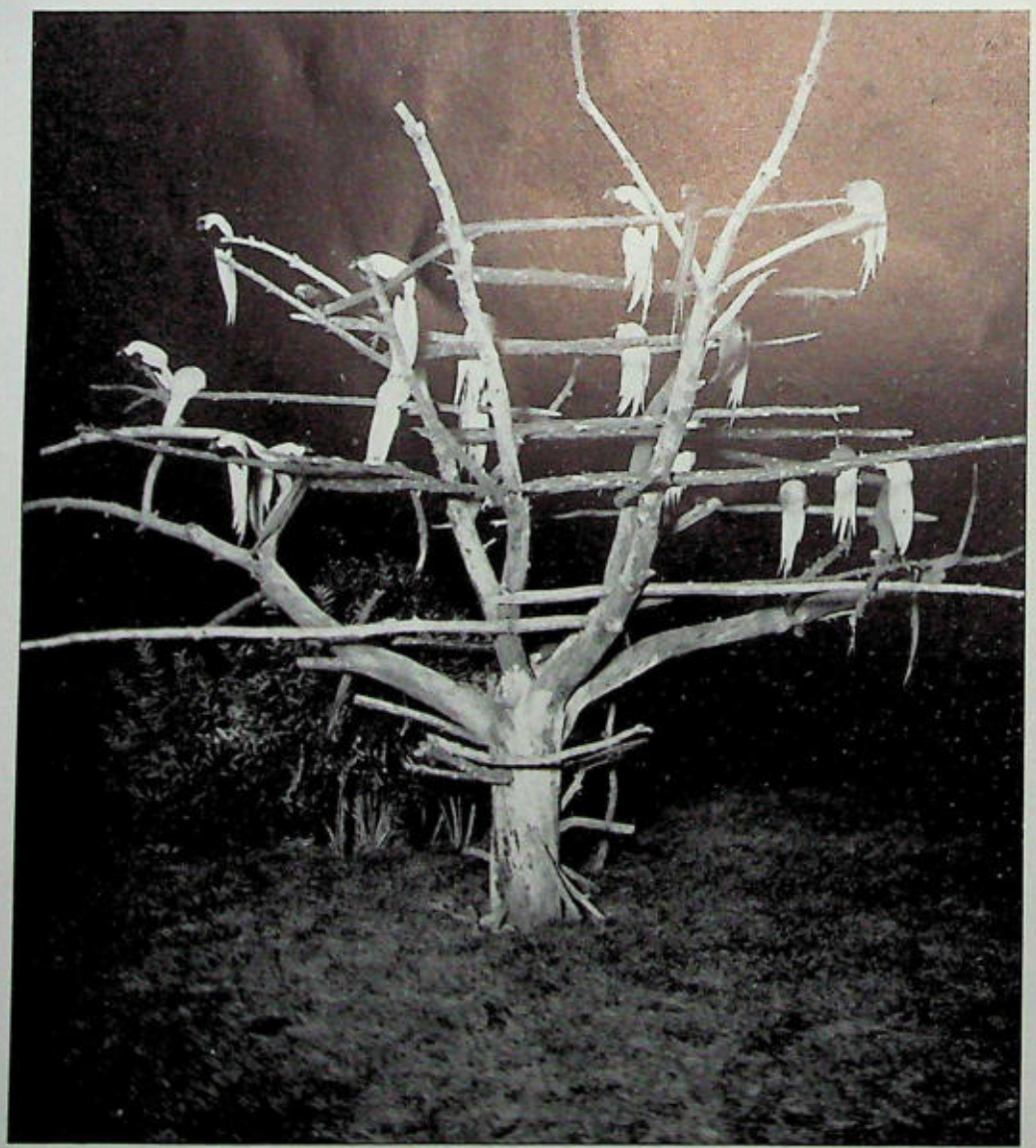


This graceful and commodious installation was presented to the Society by one of its most energetic and active officers, Colonel Anthony R. Kuser. It was originally designed for the accommodation of pheasants in the collections of Colonel Kuser on his estate in Bernardsville, New Jersey. It is used in the Park to exhibit a portion of the Society's pheasant collection. Most of the Pheasants pictured in the accompanying supplement are on exhibition in the Zoological Park. The pictures are from photographs made at Col. Kuser's estate by a New York *World* staff photographer.

Some Pheasant Pictures

From the Estate of Colonel Anthony R. Kuser

Bernardsville, N. J.



Silver Pheasants' Roost

Siver Pheasant, *Gennaeus nycthemerus*

Silver and Golden Pheasants

Golden Pheasants, *Chrysolophus pictus*

Mikado Pheasant, *Syrmaticus mikado*

Lady Amherst Pheasant, *Chrysolophus amherstiæ*

Young Silver Pheasants

Reeves Pheasant, *Syrmaticus reevesi*

NEW PHEASANT BOOKS

A Proposed New Two-Volume Edition of the Pheasant Monograph

Four years ago the fourth and last volume of the Monograph of the Pheasants appeared from the press of Witherby in London. This was the first scientific publication of importance undertaken by the Zoological Society, generously sponsored by Colonel Anthony R. Kuser and written by William Beebe.

The number of remaining sets of the Monograph has been so reduced by sales and gifts, that Colonel Kuser has now withdrawn the remainder from sale. Ever since the first publication of this $250 work, the patron and the author have received, verbally and by letter, constantly expressed demands for a less expensive edition, to be published at a price which would place it in the hands of naturalists, sportsmen and lovers of interesting books of travel and adventure.

This plan has now been brought to a focus by the definite request of Colonel Kuser for Mr. Beebe to produce an abridged edition, in two quarto volumes, to contain about forty-eight colored plates besides photogravures.

In the new edition, the detailed accounts of plumages and discussions of relationships and all other matter which is of interest only to professional ornithologists, will be omitted, and only those portions of the text retained which are of general interest, such as the actual adventures of the expedition, the habits, courtships, friends, enemies and vital activities of these beautiful birds. In almost every important review of the Monograph, there has occurred paragraphs such as the following from the IBIS:

"It is, however, in the observations which Mr. Beebe was able to make himself during his memorable journey through Asia that the greatest interest will be taken. Under the caption 'The Bird in its Haunts,' he lets himself go in vivid word pictures of the various homes of wild pheasants—the paddy-fields and reed-beds of central China, the flowery gorges of the Yangtse, the deodar forests of the Himalayas, the dense bamboo jungles of the Burmese hills, and the smiling landscape of Japan were all visited, and are here described with their characteristic pheasants." These are the parts which will compose the chief portion of the text of the new edition.

Advantage will be taken of this opportunity to bring the whole subject up to date, including the knowledge which recent exploration has contributed, such as that of Delacour in Tonkin, Andrews in Mongolia and Baker in India.

The next Bulletin of the Society will present the plans for this undertaking in greater detail. In the present number an account is offered of the strenuous trip which Mr. Beebe made through the Malay States in his search for the almost unknown ocellated argus pheasant.

E. R. S.

LIVING NATURAL HISTORY

By an error* in printing on page twenty-four of the Society's Annual Report for 1925, the following appeared in the report of the Executive Committee: "The Executive Committee have purchased one set of three films of Living Natural History, from Raymond L. Ditmars * * *." As the Society actually acquired forty-two of these motion picture reels, there is a considerable discrepancy in the number indicated.

In justice to Mr. Ditmars, Curator of Mammals and Reptiles, who is justly proud of this extensive series, the production of which was entirely financed by himself, and which continued through a period of over ten years, the error is herewith corrected.

The Society's series of the Living Natural History reels is being distributed without cost to the schools of New York City.

Attendance.—The attendance at the Park from January 1st, 1926, to June 1st, 1926, inclusive, was 776,453, while the attendance at the Aquarium for the same length of time was 570,318.

Junior Auxiliary.—The Junior Auxiliary has raised the sum of $800 which they have presented to the Society for the purchase of a South African Buffalo.

Heads and Horns.—A gift of sixteen heads, horns and tusks, part of the John Hill Prentice Collection, has been made to the Society by Mrs. John Hill Prentice, and some of the best specimens have been hung in the North reception room of the Administration Building.

Aquarium.—A contract has been let for rebuilding the defective portion of the outer wall of the Aquarium and it seems reasonable to hope that the addition to the Aquarium will be completed this summer.

* Printed as transmitted. Not typographical error.

Cartoon by Rollin Kirby in the New York "World" Published by courtesy of the "World" and Mr. Kirby

"By the rubbish in our wake, and the noble noise we make,
Be sure, be sure, we're going to do some splendid things!"—*(Kipling)*

Here we go in a flung festoon,
Half-way up to the jealous moon!
Don't you envy our pranceful bands?
Don't you wish you had extra hands?
Wouldn't you like if your tails were—so—
Curved in the shape of a Cupid's bow?
Now you're angry, but—never mind,
Brother, thy tail hangs down behind!

Here we sit in a branchy row,
Thinking of beautiful things we know;
Dreaming of deeds that we mean to do,
All complete in a minute or two—
Something noble and grand and good,
Won by merely wishing we could.
Now we're going to—never mind,
Brother, thy tail hangs down behind!

All the talk we ever have heard
Uttered by bat or beast or bird—
Hide or fin or scale or feather—
Jabber it quickly and all together!
Excellent! Wonderful! Once again!
Now we are talking just like men.
Let's pretend we are . . . never mind,
Brother, thy tail hangs down behind!

—*"Road-Song of the Bandar-Log." . . . Rudyard Kipling.*

Aquarium Number

Edited by

Dr. Charles H. Townsend and Staff of the Aquarium

Habitat Photographs of Penguins by Dr. Robert Cushman Murphy ~ Gannet and Penguin Skeletons from W. de Witt Miller ~ Photographs of Skeletons from Dr. Clyde Fisher ~ Courtesy of the American Museum of Natural History ~ Penguin Supplement and Habitat Maps arranged by Lee S. Crandall

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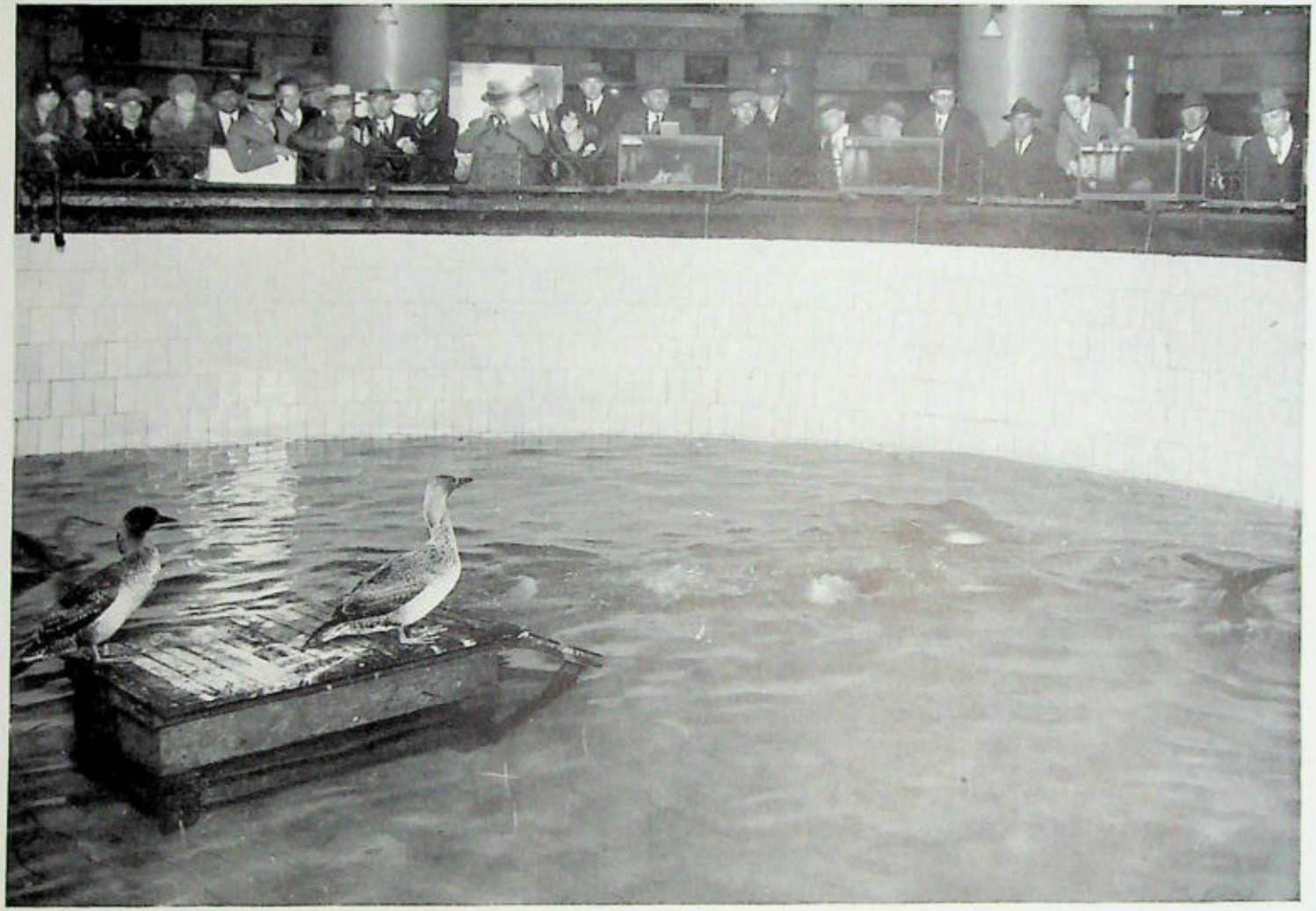


Young gannets (*Sula bassana*) in the New York Aquarium; three of the birds are diving for the fish which the keeper has tossed into the pool. From a flashlight photograph by Morris Rosenfeld.

ZOOLOGICAL SOCIETY BULLETIN

Published by the New York Zoological Society

VOLUME XXIX NOVEMBER-DECEMBER, 1926 NUMBER 6

GET ACQUAINTED WITH THE GANNET

By CHARLES HASKINS TOWNSEND

THERE are six gannets in one of the pools in the Aquarium that are among the very few sea birds of their kind to be seen alive in New York. The keeping of pelicans in the Aquarium having proved successful, we appealed to Mr. William Duval of Bonaventure Island in the Gulf of St. Lawrence for gannets, which by permission of Mr. J. B. Harkin, Commissioner of Canadian National Parks, were shipped to the Aquaruim. While the birds were lively and apparently in good health they refused all live fishes and other foods known to the gannet bill of fare. After ten days of fasting, feeding by force was resorted to. A couple of smelts and a small squid were pushed down the throat of each bird. The result of the experiment was satisfactory. On the following day the gannets fed eagerly on live fishes. The water being two feet deep the birds seemed to be unable to reach the fishes at the bottom, but when the depth had been lowered to one foot the fishes were soon caught and swallowed. The gannet lays but one egg. These young but apparently full-sized birds had been taken from their six nests on the cliffs just before flying power developed. They had probably known no foods except the partly digested fishes brought by their parents. Eating raw fish seems to be a lesson that follows the acquisition of wing power and these young gannets missed the experience of seeing adults catch and swallow fish at sea. They are as large as geese and have a wing spread of nearly six feet but are not able to fly out of the high-walled pool.

On our side of the Atlantic, the gannet breeds principally on Bonaventure Island and Bird Rock in the Gulf of St. Lawrence, as well as on two or three other islands farther north. On the European side it breeds on certain British islands and on the Faroes and Iceland. In all there are not over twenty known breeding places used by this species.

In summer it is seen occasionally along the New England coast. It winters from the coast of Virginia southward to the Gulf of Mexico, and on the other side of the Atlantic, southward to Madeira and the Canaries.

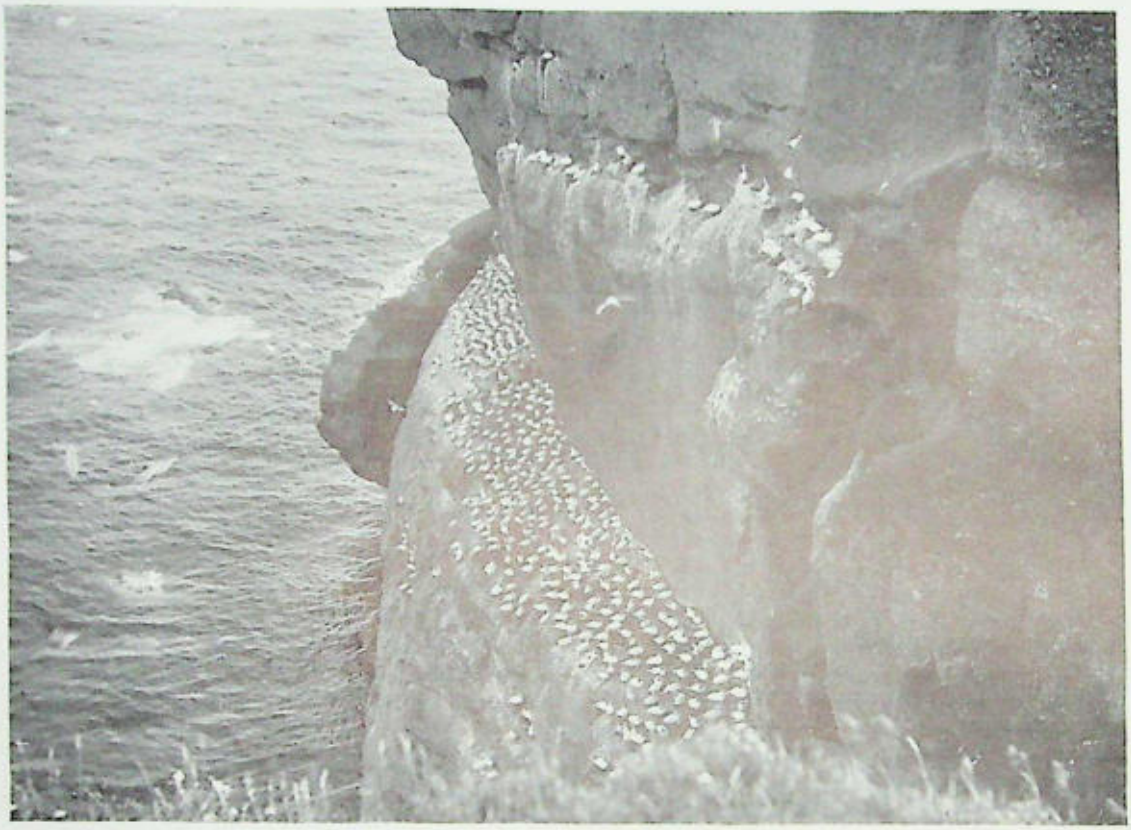
Our gannets are responsible for a greater degree of animal activity than has been observed at the Aquarium since the last of the porpoises disappeared. They are lively swimmers and occasionally fly around the pool, rising easily from the water. When not engaged in catching live minnows or otherwise occupying themselves in the water they stand on the platform preening their white-spotted plumage or taking naps with heads stowed under the back feathers.

Not being acquainted with gannets in their natural habitat we have compiled the following notes from various authorities:

Gannets when diving may be distinguished from gulls as far as the eye can see, for gulls do not habitually dive in the perpendicular manner of gannets: also the adult Gannet—a great white bird with black wing-tips is unmistakable, while the equally unmistakable "shape" and habits will serve to identify the dark young or the pied immature bird.

It requires from two to three years for the gannet to attain the white plumage of the adult, the young bird being dark brown with white spots. It breeds in large colonies on precipitous sea islands and makes usually a seaweed nest.

The gannet race is not at present a large one as sea birds go. The numbers on the various breeding places have been estimated as follows:



Nesting of gannets on Bonaventure Island, Gulf of St. Lawrence. From a photograph by Frank M. Chapman published by courtesy of the American Museum of Natural History.

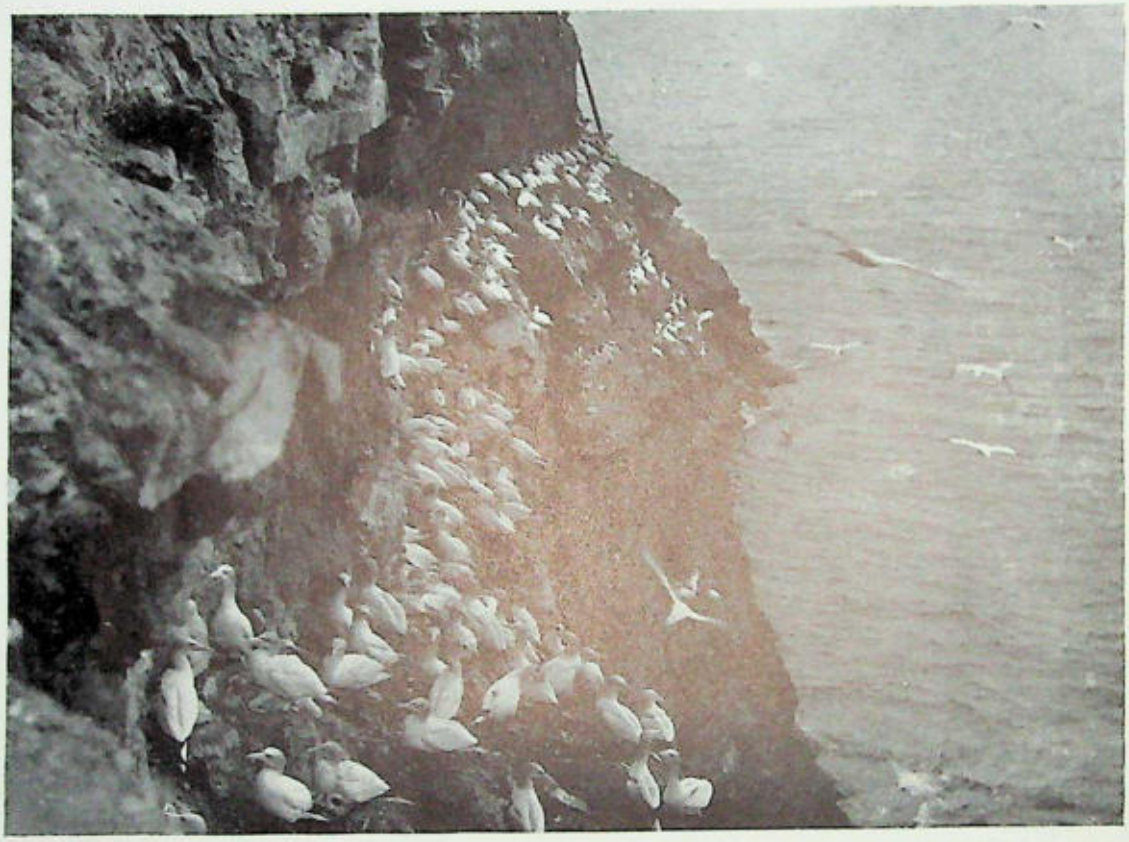
British Island, 65,900; the Faroes, 1,500; Iceland, 13,600, and Canada, including Bonaventure Island and Bird Rock, about 10,000. Formerly the gannet was more abundant.

Our gannets do not seem to be able to dive very readily from the surface. Acording to the authorities it strikes the water after a downward plunge from a height of fifty feet or more. In capitivity it requires a flight clear across the thirty-foot pool to drive the bird under water. The instinct to dive from the wing is strong and if conditions permitted the gannets would probably do some high diving. The voice of the gannet is not exactly pleasant but is not often heard, except at feeding time when they become more vociferous.

The late W. H. Hudson, naturalist and author, writes of the gannet, in part, as follows:

"One of the most notable seafowls inhabiting the British coasts is the gannet, or solan goose, a species which forms a connecting link between the cormorants and the pelicans. The origin of its two common names is not precisely known, although it seems probable that gannet is derived from gans, the ancient British name for goose. The young birds from the Bass Rock, which are largely used as food in the neighboring counties, are called, I do not know why, "Parliamentary geese." The world will have it that the bird is a goose, although as little like a goose, except in size, as a guillemot is like a sheldrake. The scientific name, *bassana* (of the Bass Rock), had its origin in the belief that the rock at the entrance to the Firth of Forth was the gannet's only breeding-place. There are several other colonies: one, now greatly diminished, on Lundy Island; another, also small, on the coast of Pembrokeshire; on the West Coast of Scotland there are four stations, and others exist on the Irish coast. None of these, however, can compare in importance with the Bass Rock, where it has been calculated that as many as ten thousand pairs congregate each year to breed.

"The gannet is an exclusively marine bird, and an inhabitant throughout the year of the seas round the British Islands. Its flight is



Gannets on their seaweed nests, Bird Rock, Gulf of St. Lawrence. From a photograph by Frank M. Chapman, published by courtesy of the American Museum of Natural History.

easy and powerful, and its appearance on the wing more pelican than cormorant-like. It feeds entirely on fish, and follows the shoals of such species as swim near the surface—mackerel, herrings, pilchards, and sprats. When fishing it sails at a considerable height, and on catching sight of its prey rises to a greater height, and then, with wings nearly closed, drops straight down, with great force, into the water. Its appearance when falling has been likened by one observer to 'a brilliant piece of white marble.' "

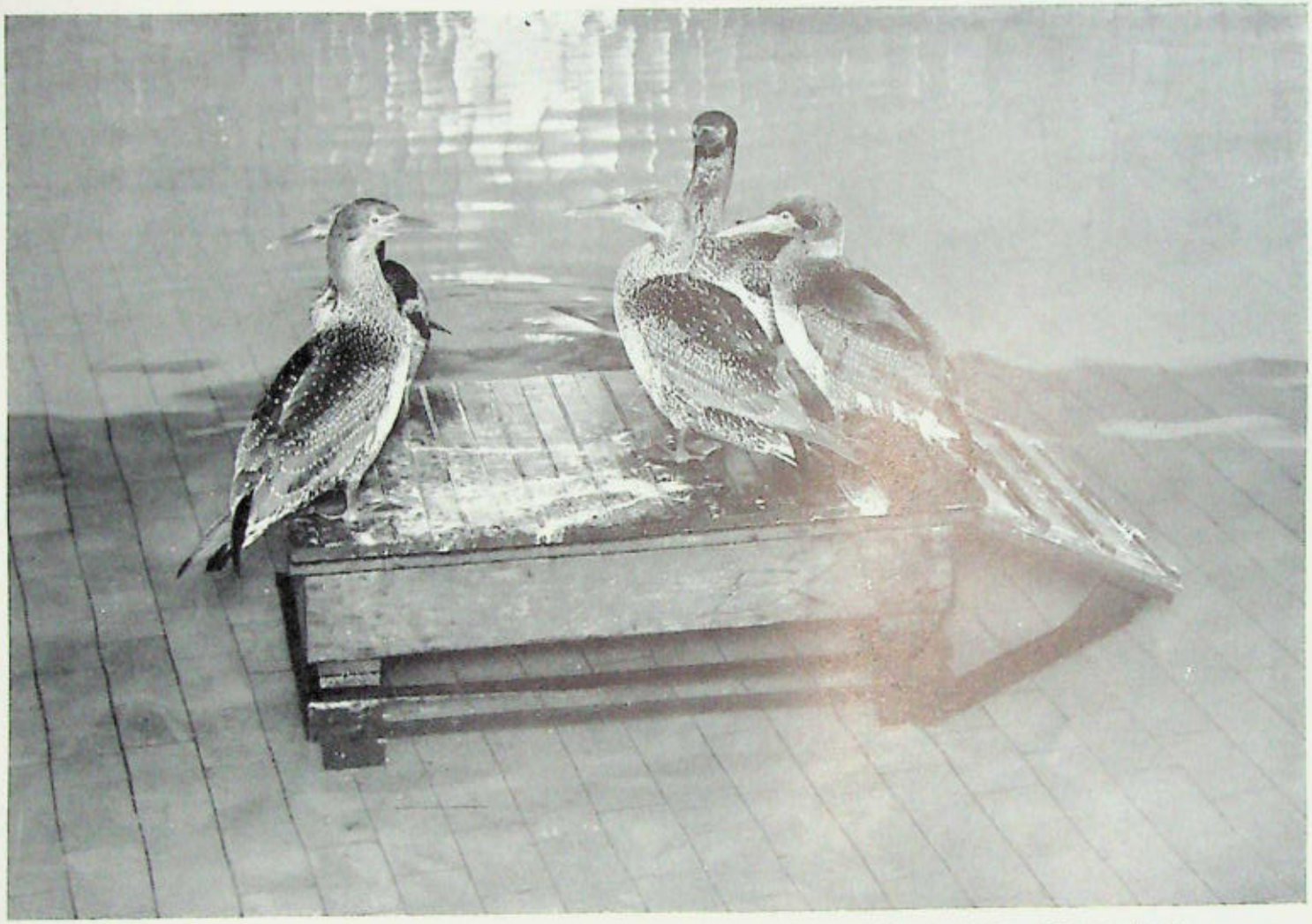
THE GALAPAGOS PENGUIN IN CAPTIVITY

By Chas. Haskins Townsend

NO sea bird exhibited at the Aquarium attracts more attention than the penguin. Our first penguin (*Spheniscus humboldti*) received in 1915, came from the coast of Chili. It adapted itself to the new conditions at once and gave every indication of enjoying life, swimming actively and feeding freely every day. A platform in the fifteen by thirty foot pool served as a resting place, as it does for the Galapagos penguins (*Spheniscus mendiculus*) now on exhibition. One of the latter was brought back by the *Arcturus* expedition last year, the other was received in April of the present year, an involuntary passenger on Mr. W. K. Vanderbilt's yacht.

The Galapagos birds are sociable and except after feeding, are eager to walk a light narrow plank whenever the space between the platform and the coping of the pool is bridged for them. Then comes the joy of waddling around the smooth coping and looking at the visitors crowded along the railing. Unlike the Chilian penguin, they rather resent being carried. When turned loose they are inclined to follow the keeper about the floor, especially if he has some live minnows.

Fishes thrown into the water interest them even more than a chance to walk the plank. They promptly give an exhibition of what hungry penguins can do under water, following the darting minnows at high speed until all are



Young gannets (*Sula bassana*) in the New York Aquarium. When adult, the gannet is snow-white, tinged buff on the head and neck, and the long wing feathers, black. From a flashlight photograph by Morris Rosenfeld.

captured. When at ease on the surface the penguin floats buoyantly, the bases of the wings being almost at the surface while the tips are thrust deep. They often submerge the eyes looking for minnows that might have escaped them.

In slow paddling the tail is usually held slightly above the surface. In scratching the head while afloat the bird turns on its side, the head is submerged and turned sidewise so that the toes can reach it.

Swimming is done with the wings, the feet serving as rudders, the webs being spread and the soles turned up. When diving for minnows the motions are so rapid that it is difficult to determine the exact position of the feet. They are apparently used only for steering.

In walking up the plank the head is held low and the back humped. In waddling around the coping of the pool the body is nearly erect while the tip of the tail almost drags.

When the bird drops into the water from coping or platform there is no head-on dive, it strikes the water flat on the breast.

When one penguin is placed on the floor, the other follows around the coping peering through the iron grill, each calling to the other with a soft "throaty" *whoo*, the bill being turned up and the throat expanded. This call is the only sound made so far as we have observed. When widely separated either bird will follow the writer while he imitates the *whoo* call. Minnows thrown on the floor are seized and swallowed very quickly.

The penguins and a Galapagos booby, occupy the platform on entirely peaceable terms and all three are adepts at catching pieces of fresh fish thrown to them. One of the penguins placed on the scales on March 12, 1926, weighed exactly six pounds, the bird being in good condition.

The moulting period lasts about three weeks, during which the penguin is listless, feeds but little and seldom enters the water.

At the Aquarium the birds occupy a large salt water pool. Their former companions, kept at the Zoological Park, did not live long, probably because they lacked sea water. When the survivors were sent to the Aquarium their first movement was the drinking of sea water. The boobies acted similarly. Sea birds that do not naturally visit fresh waters as do gulls, cormorants and white pelicans, cannot apparently survive long without sea water to drink. Those breeding about inland waters doubtless need the sea water to which they return annually when lakes and rivers are frozen. It is probable that such birds retained permanently in zoological gardens would live longer if provided with sea water to drink. A tame guillemot once kept by the writer on board the U. S. S. *Albatross* went into a decline, from which it quickly revived when given sea water to drink. We have observed gulls in Lower California after a flight across the land, to alight and drink sea water exactly as do domestic fowls.

Since the preceding was written one of the penguins died as the result of a fifteen-foot fall. The birds had been given an airing on an enclosed part of the roof, from which one unfortunately escaped. The survivor was returned to the pool where the writer a few days later observed it pacing along the platform begging to be let out. It promptly walked up the plank and was there interested only in peering through the iron grill as though it sought the missing mate on the floor. It was then turned loose in the office, every part of which it explored restlessly for half an hour, but remained silent. We placed a large mirror against a radiator which the bird found immediately and did not desert. It touched the beak of the reflected penguin, closed its eyes and rested a couple of minutes, when it began to plume its feathers. Then there followed several minutes of effort to get closer to its supposed companion. Finally, baffled by the glass, it went behind the radiator and uttered its soft *whoo*. The penguin then found its reflection in the glass door of a bookcase next to the radiator and made repeated attempts to get behind the case at each end, occasionally giving the penguin call.

The bird spent the next hour either in front of the mirror or the glass door, frequently attempting to get behind one or the other. It could not have been seeking merely a hiding place as there were such nooks nearby. Thinking the bird was wearied by its efforts to solve the mirror problem, it was sent back to the pool.

In the evening when the building was deserted I placed the penguin on the coping of the pool and concealing myself behind a pillar tried to imitate its call. The bird answered only while I kept out of sight.

On a subsequent visit to the office it remained close to the mirror and was much disturbed when the mirror was removed, looking in all directions, peering into some low shelves and calling at intervals. It then devoted its attentions to the glass door of the bookcase, but later discovered the mirror before which it remained. The penguin answered our calls only when the mirror was taken away. When the

Galapagos penguin (*Spheniscus mendiculus*) in the New York Aquarium. Gift of the Arcturus Oceanographic Expedition. From a photograph by Florence Vandamm, published by courtesy of *Vanity Fair*.

Galapagos penguin (*Spheniscus mendiculus*) in the New York Aquarium. Gift of W. K. Vanderbilt. From a photograph by Florence Vandamm, published by courtesy of *Vanity Fair*.

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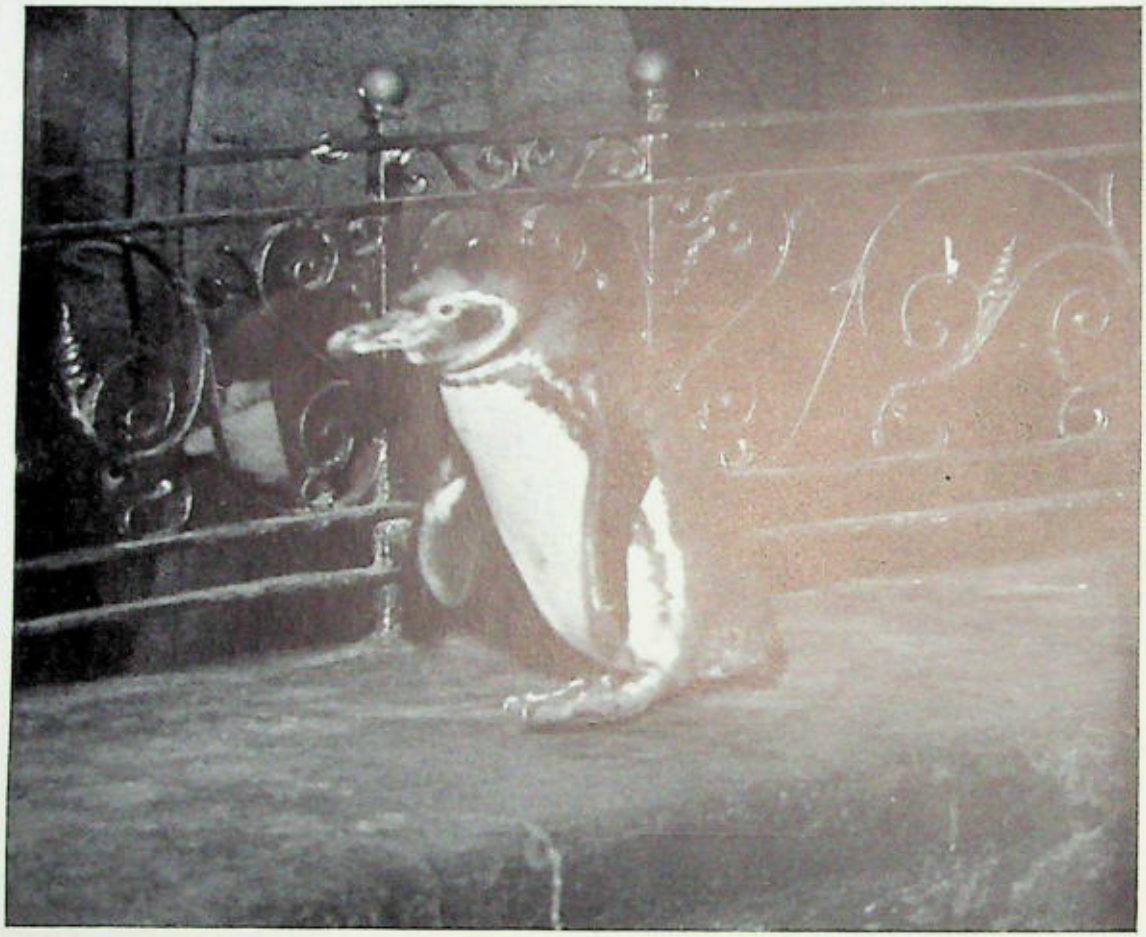


Galapagos penguin (*Spheniscus mendiculus*) in the New York Aquarium. The penguin is standing on the coping of the pool. Gift of W. K. Vanderbilt. From a photograph by Florence Vandamm, published by courtesy of *Vanity Fair*.

mirror was carried rapidly around the room the bird followed persistently as long as its reflected image could be seen.

When the penguin was placed on a chair beside a small aquarium it at once became interested in the occupants, making repeated attempts to seize the minnows and goldfishes that swam nearest the glass. Further experiments with this bird may present other aspects of penguin behavior.

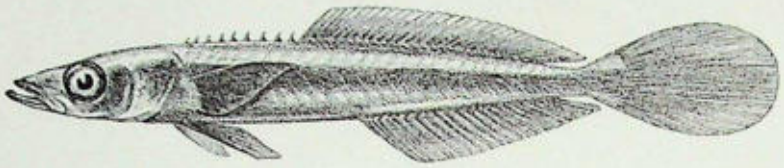
A SMALL COBIA

By C. M. Breder, Jr.

THE specimen upon which the accompanying figure is based was brought to the Aquarium from Hempstead Bay, Long Island, in September, 1925. At that time it was approximately 80 mm. long. It lived at the Aquarium for about two months during which time it grew to a length of 98 mm.

Young cobias (*Rachycentron canadus*) of such a small size are known from only a few specimens and this is the only one we know of that has been observed in an aquarium. The adults are common along the coasts of the southern states and are occasionally taken in local waters. Such specimens that form the basis of the local records are generally of about three feet in length.

The most striking features of the young are their marked differences from the adults in the form of the tail, in coloration and in locomotor habits. The adult cobia has a slightly forked tail, well pointed at either tip. It would seem that the outer rays of the tail fin simply grow at a greater rate than the central ones by the time a certain size is reached.



Crab-eater (*Rachycentron canadus*) which in general outline resembles the shark-suckers (*Remora* and *Echeneis*).

The impression is given, at first glance of an exceedingly black fish although a closer examination reveals distinct markings. However, these are subject to considerable change from time to time. Notes made on the specimen when received give the following color description.

For the most part uniformly jet black excepting that the dorsal is edged with milk white, the anterior part of the anal tipped with it and the caudal so edged above and below. The pectorals are transparent distally. Two ill defined and evanescent lateral streaks of an iridescent greenish brassy, run from the snout to the tail. The figure indicates the departure made from these markings after its sojourn at the Aquarium.

The adult cobias manipulate their pectoral fins in a manner which reminds one of a shark. That is, these fins are generally held out rather rigidly and simply "warped" for turning and wheeling. In this young specimen, however, they were the most active appendages, being used frequently for inducing locomotion in a manner not very different from that employed by the slippery dick (*Iridio*). The large spatulate tail was also used as an impelling agent but appeared to be secondary to the pectorals and was more often used as a rudder.

REMARKABLE ATTITUDES OF THE ELEPHANT SEAL

By C. H. Townsend

SOME of the attitudes commonly assumed by the Antarctic Elephant Seal (*Mirounga leonina*) are apparently impossible to its near relative, the Northern Elephant Seal (*Mirounga angustirostris*).

These are well shown in the numerous photographs of both species now available for comparison. The photographs provided by Mr. Hagenbeck for this number of the Bulletin are more striking in this respect than those taken in South Georgia by Dr. R. C. Murphy, or at Kerguelen by Mr. T. P. A. Ring.

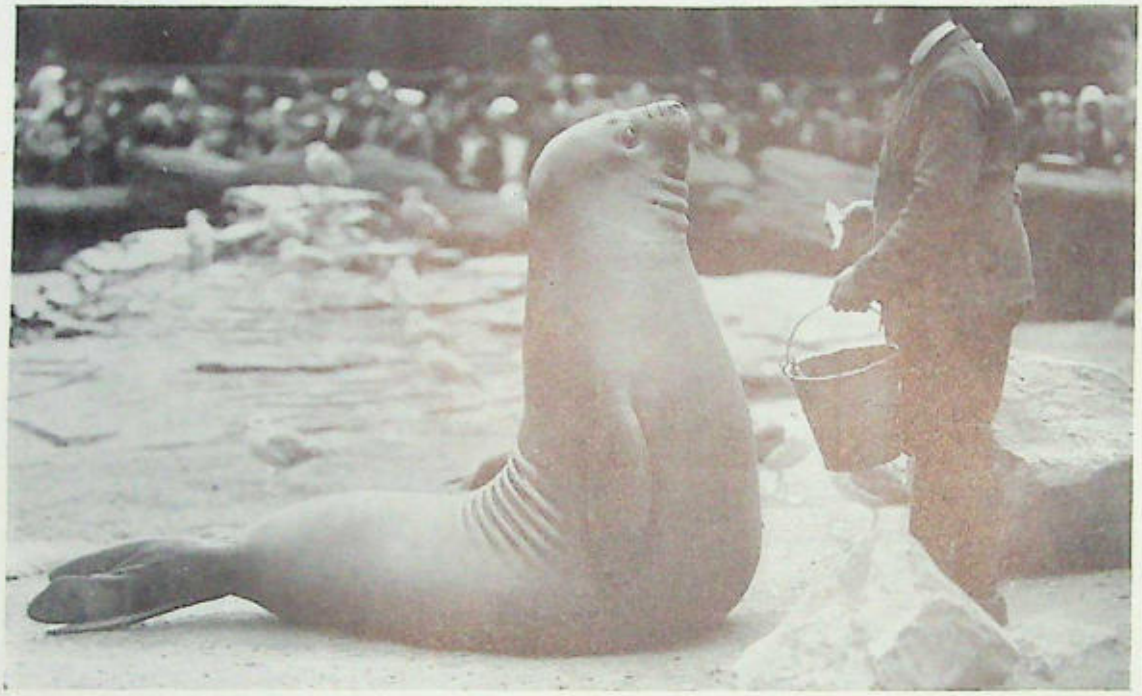
The Antarctic species is capable of erecting the anterior half of the body until it is at right angles with the posterior half resting on the ground. The bulk of its weight in this position seems to be thrown altogether on the stomach. It can furthermore be induced to lean backward until the top of the head is brought close to the tail, the heavy skin of the back deeply wrinkled, and the great weight bears on the abdominal region until it is flattened by the pressure.

The exceedingly heavy fore quarters often rise until the tips of the hanging flippers are lifted entirely clear of the ground. The practice is so common that it appears to cause the animal no discomfort.

The Northern Elephant Seal can do nothing of the sort. The writer has made many photographs at Guadelupe Island and has copies of photographs made there by others. In none of the grotesque positions regularly assumed, are the lower chest and flippers ever raised. Both species are equally large. Three males killed by the writer for museum specimens averaged sixteen feet in length and eleven in girth behind the flippers. They were so heavy that it required all the strength of six men to turn them over. Nothing is known about the actual weight of any large elephant seal.

The longest known length of the northern species is twenty-two feet.

The largest elephant seal shown in Mr. Hagenbeck's pictures is a male fifteen feet long. The photographs were all made at Stellingen where the Hagenbeck Thierpark is located.



Antarctic elephant seal (*Mirounga leonina*) in Hagenbeck's Tierpark, Stellingen, Germany. Published by courtesy of Lorenz and Heinrich Hagenbeck.

Antarctic elephant seal, Tierpark, Stellingen. A male fifteen feet long with fore-quarters lifted from the ground. Published by courtesy of Lorenz and Heinrich Hagenbeck.

Antarctic elephant seal, Tierpark, Stellingen. A fifteen-foot male with flippers raised from the ground. Published by courtesy of Lorenz and Heinrich Hagenbeck.

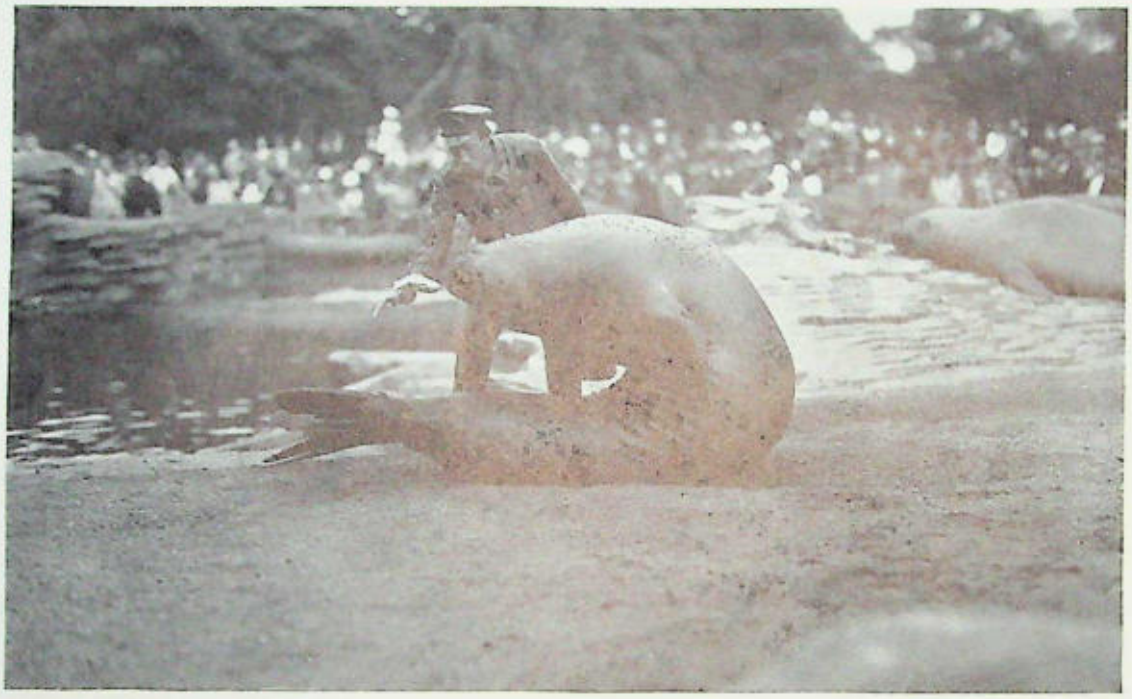
NEW MEDICINES FOR SICK FISHES

By Ida M. Mellen

IN June (1926) there was so much sickness, infection and disease from parasitic and other causes among fishes and other animals in the New York Aquarium, that Director Townsend asked the present writer to apply some remedies. Those recommended in Fishes in the Home were used, and medicaments new to fishes were also introduced. In a few cases the treatments were found wanting, in most cases they were amazingly effective. At least one will doubtless become one of the most valuable remedies for ailing fishes.

Several baby turtles in the office turtle bowl had already been cured of blindness by daily applications of boracic acid, and a tadpole with a sore back had been entirely cured by a few applications of kerosene.

Those who have much to do with turtles know that whether wild or captive, they are as prone to tumors as any known animal. These growths generally develop on the neck, but sometimes on the flippers. A hard tumor is not apt to attach to an artery or other vital part and can be cut out with a sharp scissors, and with the drawing of practically no blood. If the wound is sprinkled with xeroform after the operation and the animal kept dry for half an hour, and the wound sprinkled thereafter on one or two days in succession, or as may appear needful, it will disappear in a few weeks. In treating soft tumors, another method must be chosen.



Antarctic elephant seal, Tierpark, Stellingen. Bending backward to seize a fish. Published by courtesy of Lorenz and Heinrich Hagenbeck.

A gentleman walked into the writer's office one day and announced that he had brought a souvenir. It was a small lump of dried meat like a bit of old beef.

"This," said he, "is one of the tumors you cured my turtle of."

The specimen was a box tortoise with a soft tumor on each side of its neck, and directions had been followed by applying hot water daily and after thoroughly drying, painting with iodine.

Iodine is excellent for land animals, but must be used with caution in the case of water-inhabiting creatures, for if the spot is not well dried first, the iodine may prove merely ineffective or may create a sore all around it, thus defeating its own ends.

The tumors in this gentleman's turtle gradually became smaller and the animal began to make attempts to draw its head into the shell. This caused the tumors to assume a long, narrow shape, and finally they dropped off.

The Director called attention also to some axolotls whose toes, tails and gills had been eaten off by sunfishes. They had developed a coating of water mould (*Saprolegnia*) an inch long on all the affected parts and were in a pitiful condition. Kerosene oil, brushed on the legs, gills and tails, caused the fungus to drop off. The specimens were then placed in a muddy aquarium and they never needed a second treatment. The regeneration of the toes was an interesting process, and began in a few weeks. The regeneration of the gills was slower, not commencing for about two months.

The next patients Dr. Townsend referred to me were a dozen large, valuable comet goldfishes from the Bruce Goldfish Fisheries, which had not yielded to the usual salt and permanganate of potassium baths. They showed no sign of disease, but had become cloudy and listless and were lying on the bottom of the tank, ready to die. In other words, they were suffering from debility and failure of the slime organs to function properly. All twelve were placed by turns in a bucket of kerosene for one and a half minutes, then in a reserve tank of fresh water into which a strong flow of salt water was introduced. They went back on exhibition about ten days later, bright and shining as when they had come from the goldfish farm in Iowa. And thus, with half a dollar's worth of kerosene, we saved over a hundred dollars' worth of fancy goldfishes; and the kerosene was used many times afterward for other specimens.

Kerosene for external use in treating fishes is an old remedy; but the idea of dropping the

fish itself into the oil appears to have originated with Mr. Harry P. Peters of Philadelphia, who mentioned it to the writer several years ago. It is one of the few solutions that will keep indefinitely and is not spoiled by use. And it is one of the least expensive.

Another lot of common, straight-tailed goldfishes came in from the Park lakes in wretched condition and were what would ordinarily have been considered hopeless. Some were actually floating on top of the water, to all appearances done for. Whether automobile oil draining into the lakes brought them to such a state, or what was the cause, cannot be accurately stated. Into a bucket containing a solution of aluminum sulphate, chemically pure, one ounce to the gallon of water, three hundred and seven specimens were dropped, three at a time, for from one to three minutes—the lesser period if but slightly affected, the longer if the case was bad. The next morning the man in charge of fresh-water fishes reported but two dead, the remainder much improved. They have been continuously on exhibition ever since.

One of the most dread diseases among fresh-water fishes is caused by a protozoan parasite that embeds itself in the scales and breeds there. Eventually the entire body is dotted with the white pits containing these parasites. The United States Bureau of Fisheries says no cure is known that will not also kill the fish. A lot of white bass just received from the Detroit Aquarium by exchange, were completely speckled with these white spots. Not a scale on them

Antarctic elephant seal, Tierpark, Stellingen. Published by courtesy of Lorenz and Heinrich Hagenbeck.

appeared to have escaped. Three of the lot were cured of the disease and eventually went back on exhibition; but they never regained their appetites and were finally lost. If they could have been fed with live food for a few days to get them into the habit of eating again, we could probably have saved them. Several remedies were tried for this disease, which is called Ichthyophthiriasis, from *Ichthyophthirius multifilius*, the parasite that causes it. Mercurochrome—a drug first used upon fishes by Mr. Wallace Adams of the Steinhart Aquarium in San Francisco—was introduced into the tank in a strongly colored solution (grains being used) after the water had been lowered. The tank was then allowed to fill as slowly as possib'e. Mr. Adams had found that this drug would sterilize both plants and animals and could be used for several days in succession, the only difficulty being its facility for discoloring everything it touches. His experiments were with balanced aquaria, and he used five drops of a two per cent. solution to each gallon of water. With cold water specimens its use is more difficult. It is, however, more effective for this disease than is kerosene, and the white spots could be seen to grow less in number. The most satisfactory results were obtained with ammonia solution, eight drops to the gallon of water, for a one-minute bath. This treatment also appeared to be effective with flukes in the gills of albino trout, though it was puzzling to tell which fishes had the flukes and which had not.

Now a new and terrible disaster befell our angel and spade fishes. Their eyes were becoming first clouded over, then swollen, then inflamed and bulging, and finally blind, with holes instead of pupils, and at last there was only a round, white disc where the eye had been.

In the early stages, small, white spots appeared on the eyes, accompanied by a reddish brown thread that in some instances hung half an inch from the body of the fish. The white spots under the microscope turned out to be flukes (trematode worms) and the brown threads were composed of microscopic bodies, triangular in shape, with a hook on one corner and a connecting thread on another. They looked for all the world like protozoa of the genus *Heteromita*.

Dr. George A. MacCallum, former pathologist of the New York Zoological Society, very kindly agreed to look over the material and later identified the flukes as a species of *Epibdella*—ectoparasitic worms—and the brown threads as their egg cases.

To find out what would kill the flukes and not hurt the eye of the fish, boracic acid was first resorted to. It killed the flukes in varying periods of from one and a half to four and a half minutes. This was not altogether satisfactory. Argyrol was next used, and proved of no avail. The flukes enjoyed dabbling in it. Dakin's solution killed them in from fifteen to twenty seconds, and a physician had told the writer that it could be used in human eyes. After trying in vain to reach this physician and ascertain the proper solution to be used, the suggestion to try silvol was received from my own doctor, Frances Peele Beebe of Brooklyn.

This was a big moment in the history of the treatment of fish diseases, for silvol turned out to be well-nigh a panacea for salt water species. It killed the flukes in fifteen seconds in ten per cent. solution; it also killed protozoan parasites attached to fins, healed sore spots and soothed bruises—and it did no harm to the gills of the fish, the most delicate spots one can touch with a chemical.

On silvol we therefore pinned our faith, and with the first treatment fishes in torment quieted down, and those blind specimens whose pupils had not been destroyed, gradually regained their sight.

It was evident that greater results could be obtained if we could have a sufficient quantity of this expensive material to make up a two-gallon solution. We had invested in only a few ounces. On receipt of an explanation of the situation, Messrs. Parke, Davis & Co., of Detroit, manufacturers of this drug, very generously donated two pounds of it, and this permitted of dropping the fish into a bucket of the solution and killing any of the flukes that might be lodged on the skin.

Fishes showed varying degrees of resistance to complete immersion, some evidencing no inconvenience for three minutes in ten per cent. solution, and one little grunt, used by way of experiment, recovered after five minutes in the solution. This drug has not yet been tried in the treatment of Ichthyophthiriasis. It was mixed with salt or fresh water, according to the species of fishes to be doctored.

On July 23, we came into possession (also from the Park lakes) of twenty of the very worst specimens of goldfishes ever brought into the New York Aquarium. They could not have lived a week, and were suffering from plant and animal parasites, tail rot, dropsy, pop eye, abrasions and inflamed red spots on various parts of the body, sore eyes, and a disease known as the "black fungus"—which under the

microscope proved to be not at all as shocking as it sounds, for it was, to all appearances, nothing more than a disturbance of pigmentation. Sixteen of the twenty were completely cured and ready to go on exhibition a month later.

From the gills backward, some of the specimens were dipped first into turpentine and then into fifty per cent. solution of peroxide of hydrogen. On others only the peroxide was used. One pop eye was operated on successfully. Three specimens were badly swollen, and one of these recovered after swallowing (under protest) a teaspoonful of castor oil. The fish was held upright with a wet rag wound around the gills to prevent contact of air with the gills and also to prevent ejecting the oil through the gills. The oil was then dropped into the mouth. This dosing requires patience, for the fish will hold the oil in its mouth for five minutes or more, hoping to get back into the water and spit it out. By waiting until he gives up hope and is obliged to swallow it, our efforts are rewarded—by a well fish a few days later. Fish psychology is very simple. You don't need to psychoanalyze your patient in order to cure him of his fixations.

The other two swollen specimens were different. Their cases were manifestly either egg-binding, dropsy or tumor. Forceps were used to relieve the fishes of eggs, but there were no eggs. Operation for dropsy showed the bodies filled with water. This, then, was the trouble and not tumor, and, as dropsy is an incurable disease, the specimens were lost, though not for a week in one case, and for four weeks in the other.

For bad eyes and sore spots on head and gill covers and around pectoral fins, silvol was used. Some of the lot were entirely well in a week, and six were treated ten days later in the same way as on the first occasion. One had a broken jaw with the bone protruding and of course a very sore mouth. This bone was cut off, and the sore flesh around it treated with silvol. Some superfluous flesh was cut away ten days later and the spot treated again. This fish was saved more easily than though it had a germ disease, and was cured in twenty days.

Just as the first draft of this paper was written, our long-nosed gars became covered with argulids—crustacean parasites found on fishes in both salt and fresh waters and also on whales. One species common on goldfishes is called the "carp louse," though not related to lice in any way. A crustacean parasite of the whale is known as the "whale louse." These parasites are large or small, according to the size of the host: an eighth of an inch on the goldfish, a quarter of an inch on the gars, and an inch or more on larger fishes.

The gars were transferred to a reserve tank after hundreds of the parasites had been scraped off them and placed in jars of water. No drug ever had been found that would kill these pests without killing their host.

In solutions in which one would confidently expect them to succumb, the pests capered around with tantalizing abandon. They lived a day or two in very strong salt water, gentian violet and ammonia solutions. They survived for an hour or more in silvol, aluminum sulphate (two and a half ounces to the gallon of water), kerosene, formalin (ten drops to the quart of water), copper sulphate, and alcohol fifty per cent.

As gars are ganoid fishes and can live for some time out of water, it ocurred to me that the parasites might be allowed to dry up. The result of this experiment was that after three and a half hours on a glass slide, they appeared dead, but when the slide was suspended in water they came to life in three seconds and swam delightedly about.

In turpentine they succumbed in from two and a half to three and a half minutes, but this was too biting to be tried on the gills of a gar. In cello-solve (a new drug donated for the experiments by a physician friend) they expired in nine and a quarter minutes; in mercurochrome in one hour and twenty-five minutes.

The only drug that killed them instantly was iodine undiluted, and this could not be applied to the gills of the fish. In a solution of forty drops to the pint of water, the argulids died in three minutes, or, if still kicking, did not revive when placed in water. Acetic acid had been used successfully on fingerlings for fifteen seconds, two and a half per cent. solution, according to the Bureau of Fisheries reports, and it was tried on the argulids. One died in three minutes, four in five minutes, four in six minutes, and one in seven minutes. Would the gars live in these solutions for three and seven minutes respectively? A specimen was tried in each, and though the fishes came out alive and swam about, they died within a few minutes.

The Director caused a metal trough to be constructed, six inches wide, six inches high, and five feet long. This would hold the longest of our gars and require a minimum amount of any solution to be used. It proved very con-

venient for treating the gars, especially where baths were used for only a few minutes; but the gars were unable to live in the narrow trough, with its limited air supply, for more than five and a half hours, and some of the treatments necessitated a longer period than this. Only one specimen was lost in making this discovery, however.

Vacation was postponed for two weeks in the hope of concluding the experiments, but it was impossible to work out the problem of the gars and their argulid parasites in the limited time. In a solution of mercurochrome so strong that the fish came out dyed scarlet after five hours' immersion, the argulids were all killed and the fish was no worse for the bath. Its normal coloration was reëstablished over night. Now this was the solution that, in a stender-dish, had killed the parasites in one hour and twenty-five minutes; but an important fact is that argulids die much quicker in half an ounce of solution, unattached to the host, than when the host is submerged and they have a chance to cling and possibly to retain some water in their suction disc. No rule can be based upon the results of one experiment, and it will be necessary upon the next infestation of gars by these parasites to carry the experiments farther. We know that the miracle has been performed with one specimen, of killing its parasites without killing the fish, and we can only hope to show that this can always be done.

Both Max Cochran, in charge of salt water fishes, and Michael King, in charge of fresh-water fishes, gave every possible assistance in this difficult work, and the floor men were eager to call attention to sick specimens of every sort, even at the risk of discomfort to themselves. While the work was outside the usual line of duties, and entirely gratuitous, it was not without its satisfactions; for Dr. MacCallum found that the terrible fluke had not been previously described, and he offered to describe it and name it after the present writer. Is it not some reward to have something named after one, even though it be but a horrid worm?

The practical conclusion one must reach on summing up the results of these experiments is, that a few dollars expended in saving sick specimens would mean hundreds less to be spent in collecting. With these animals it is the same as with human beings; one must watch sharply for sickness and act promptly.

HAITIAN EXPEDITION OF THE DEPARTMENT OF TROPICAL RESEARCH

The Tenth Expedition of the Zoological Society will start from New York on December 28th, on a four-masted schooner of 800 tons, bound for the Gulf of Gonave, Haiti. Here, William Beebe with a staff of eight, will spend four months, living in tents on the deck of the schooner, studying the fish and other life of the coral reefs, and the land vertebrates peculiar to the island. Especial efforts will be made to capture the rare mammal Solenodon alive and birds new to the collection of the Zoological Park.

A complete outfit for undersea photography has been assembled, and it is hoped that excellent pictures will be obtained of sharks at close range, showing their disregard of a living man, and their instant reaction to one of their own kind when hooked.

Probably the most important result will be the demonstration of the astonishingly low cost of an expedition such as this when an inexpensive schooner, by the use of tents, is turned into a comfortable houseboat and laboratory.

MEMBERSHIP OF THE SOCIETY

The following persons were elected members of the Society, November 10, 1926, by the Executive Committee:

Life

Leo S. Bing
Howard L. Goodhart
James B. Pond

Annual

Mrs. Alma Berger
Miss Edith Frances Biddle
Alexander M. Bing
Goodwin Batterson Beach
David Challinor
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Irving Cox
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William Christian Speers
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W. H. Von Bergen
Wm. H. Zinsser

New York Zoological Society

OBJECTS OF THE SOCIETY

¶ A PUBLIC ZOOLOGICAL PARK. ¶ A PUBLIC AQUARIUM. ¶ THE PRESERVATION OF OUR NATIVE ANIMALS. ¶ THE PROMOTION OF ZOOLOGY.

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Departments:

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Aquarium — Charles H. Townsend

Birds — Lee S. Crandall

Mammals—Reptiles — Raymond L. Ditmars

William Beebe
Director, Tropical Research: Honorary Curator, Birds

Each author is responsible for the scientific accuracy and the proof reading of his contribution.

Members of the Zoological Society are entitled to all publications, Reports, Bulletins, Zoologica, etc., (Zoologica mailed by request only) and no effort will be spared to ensure their delivery. Changes of address, forwarding points and non-delivery of mail should be stated promptly. Contributions pertinent to the objects of the Bulletin cordially welcome. Stamped and return envelope should accompany communications. Address Editorial and Subscription Offices, Zoological Park, New York City. Elwin R. Sanborn, Editor.

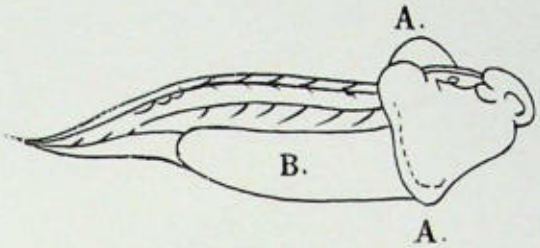
Vol. XXIX Nov-Dec, 1926 No. 6

THE CENTRAL EUROPEAN BITTERLING FOUND IN THE STATES*

By E. Bade

ABOUT two years ago an interesting ichthyological discovery was made in a brook near Tarrytown, N. Y. This consisted in the finding of schools of "bitterlings" (*Rhodeus amarus,* Bloch). No one knew what kind of fish these were, no literature of American ichthyology mentioned this form, and no one knows how these fish ever came into this tiny stream, although there is a very reasonable explanation of how they may have come into this particular body of water. It is very probable that, about ten years ago when the hobby of raising and breeding fish had its humble beginning, a fancier imported a number of these fish, placing a few into this tiny stream where they have been able to multiply unhindered.

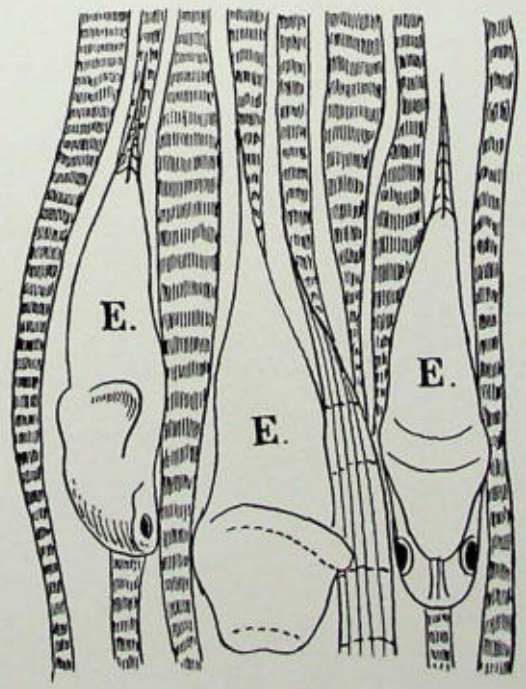
* The New York Aquarium is exhibiting a tank full of bitterling collected in Westchester County, where they are now plentiful.



Embryo of the "bitterling." A. Swellings. B. Yolk sack.

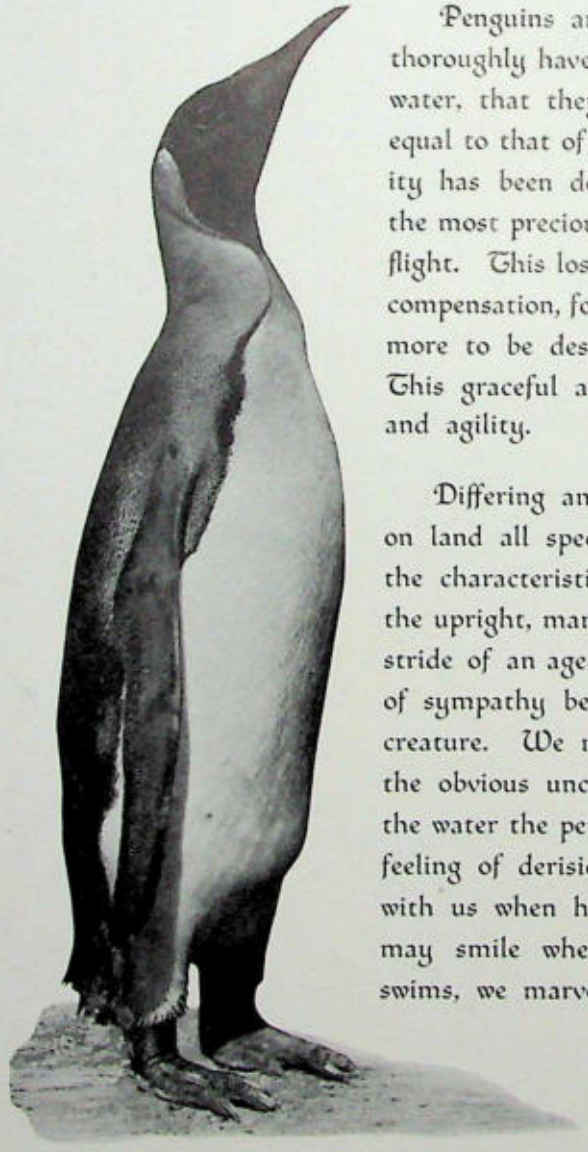
In the life of this tiny carp a peculiar affinity exists between it and a fresh water mussel, in fact the fish is entirely dependent upon the mussel for the propagation of the species. At the time of spawning, which may last from the end of April through May into June, the gayly colored male chases the female in high spirits. The scaly dress of the lively creature reflects the fieriest colors, the sides are blue, the under side is bright red, a longitudinal stripe on the caudal is emerald green and the eye gleams with orange fire. At certain times the entire body of the male seems to glow with an internal light. As the spawning period approaches and as the male assumes its brighter garments, a change takes place in the skin above the upper lip. Here, just above and at the extremity of the upper jaw bone, a round protuberance is formed which consists of an irregu-

(*continued on page 205*)



Embryos of the "bitterling" in the gill cavity of a fresh-water mussel.

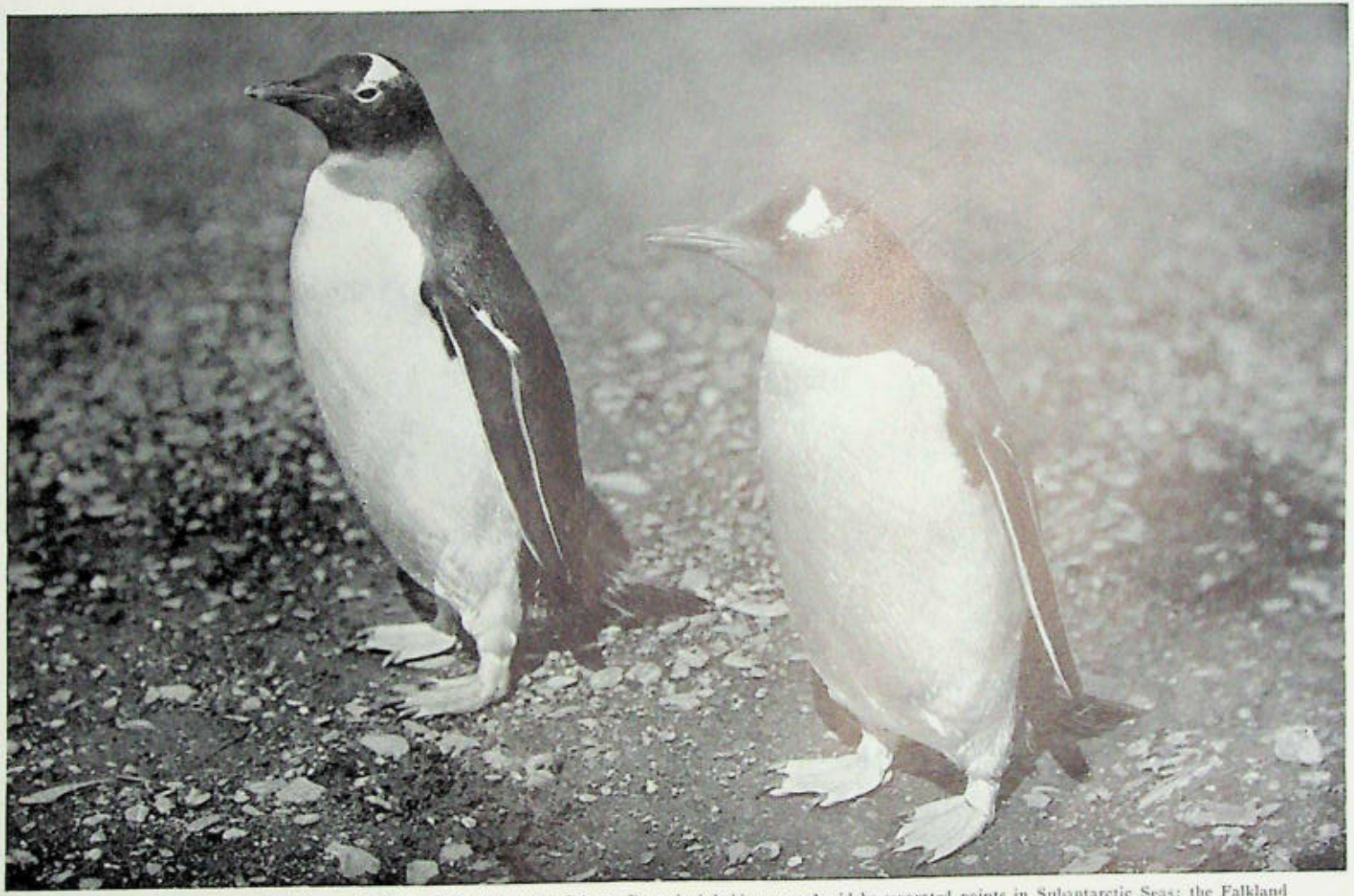
WITH the single exception of the diminutive Galapagos species, which lives almost directly on the Equator, the penguins frequent the cheerless shores of Antarctic and Subantarctic Seas. Some seventeen forms have been described, and it is quite possible that others may still be included amongst the still hidden mysteries of the frozen south.



Penguins are the most aquatic of birds. So thoroughly have they become adapted to life in the water, that they have acquired a skill in swimming equal to that of the seals and fishes. Yet this ability has been dearly bought, for it has cost them the most precious heritage of bird life, the power of flight. This loss, of course, is not entirely without compensation, for flight through the air is but little more to be desired than flight through the water. This graceful act the penguin performs with ease and agility.

Differing amongst themselves in minor points, on land all species of penguins possess in common the characteristics that have most appeal for us—the upright, man-like posture and careful, measured stride of an aged person. There is a distinct bond of sympathy between ourselves and this slow-going creature. We may even contemplate humorously the obvious uncertainty of his gait. But once in the water the penguin is transformed, and our vague feeling of derision vanishes. He ceases to be kin with us when he enters the realm of fishes. We may smile when a penguin walks, but when he swims, we marvel.

By Lee S. Crandall



Johnny or Gentoo Penguin. *Pygoscelis papua* (Forster). The Johnny Penguin inhabits several widely separated points in Subantarctic Seas; the Falkland Islands, South Georgia, Kerguelin Island, Macquarie Island, etc. It is a bird of medium size, as penguins go, measuring thirty inches from tip of beak to the end of the feet, when fully extended. In color, it is slaty-blue above, with brownish head and neck, a white breast, and a white band across the head, between the eyes.

Photograph, Dr. Robert Cushman Murphy; Courtesy of American Museum, Natural History

Penguins differ considerably in nesting habits, the Johnny Penguin being included among those species which build nests and incubate in conventional bird fashion. Two eggs are laid and the parents alternate in sitting. The birds nest in rookeries, which are often extensive and some distance from the shore. Paths through the snows to the rookery become deeply trodden by the passage of many feet.

Young Johnny Penguins. Dr. Robert Cushman Murphy in *"The Penguins of South Georgia"* writes: "Among the hills of South Georgia, I found a clear pool of fresh water, its bottom thickly strewn with bodies of penguins which had outlived the perils of the sea and had apparently accomplished the rare feat among wild animals of dying a natural death. They lay by scores all over the stony bed of the pool . . . their breasts reflecting gleams of white from the deeper water . . . for months, perhaps years, they would undergo no bodily change in their frigid graves."

Photograph, Dr. Robert Cushman Murphy; Courtesy of American Museum, Natural History

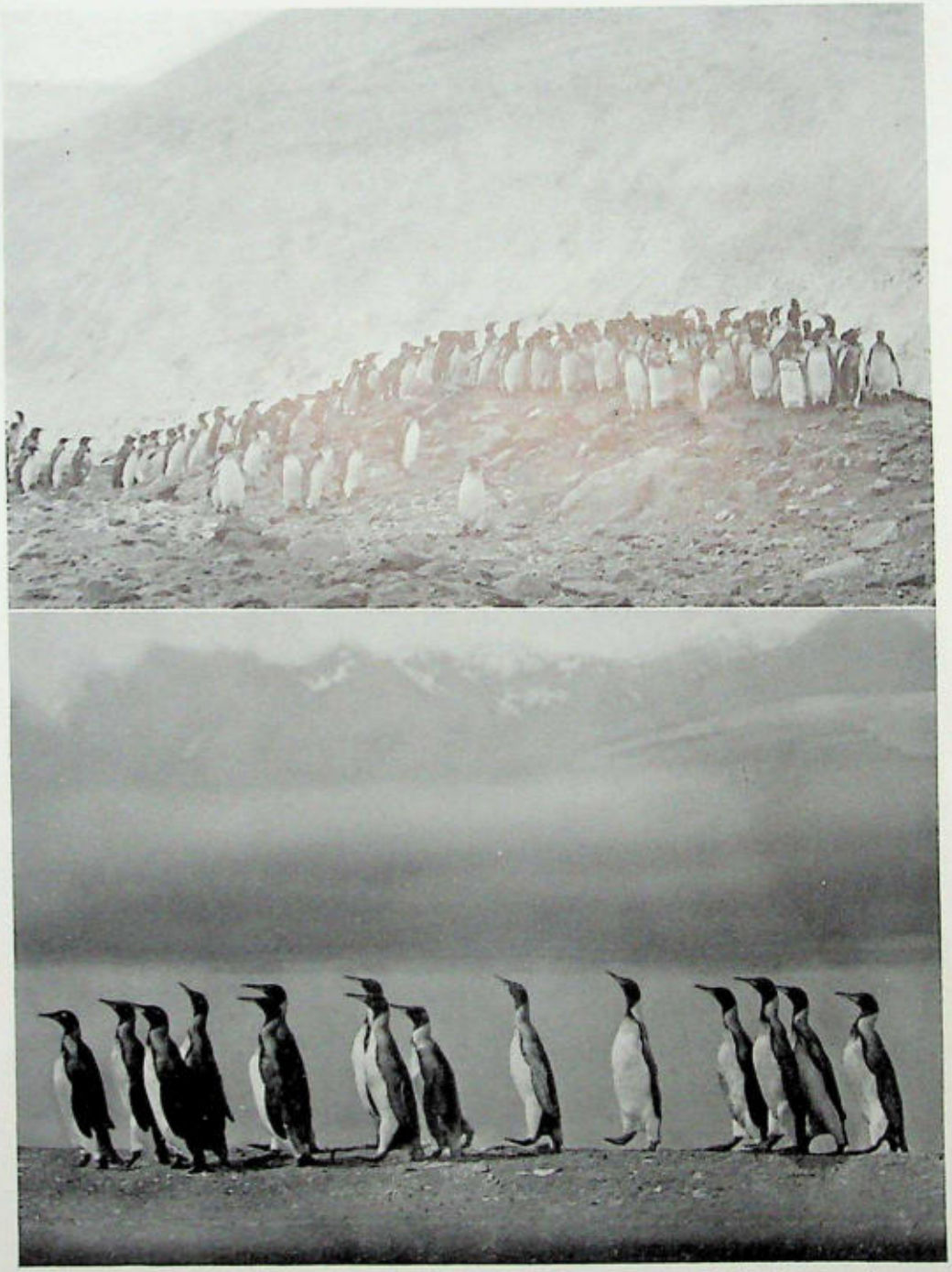
A Brooding King Penguin. The King Penguin builds no nest. It provides even a better repository, for the incubating bird holds the egg on its legs and feet, folding over it a soft, warm flap of down-covered skin. The parents take turns in caring for the precious burden, rolling it, with the greatest care, from feet to feet.

Yearling King Penguin, still in down plumage. The vaguely familiar appearance of this youngster may be attributed to the resemblance between its downy covering and a racoon-skin coat. King Penguins in down are believed never to enter the water and are still dependent on their parents for food.

Photograph, Dr. Robert Cushman Murphy; Courtesy of American Museum, Natural History

King Penguin hovering young. After the young penguin is hatched, it is brooded by its parents in the same manner as was the egg. The chick is fed with liquid, predigested food, which the parent regurgitates for the benefit of its offspring.

Photograph, Dr. Robert Cushman Murphy; Courtesy of American Museum, Natural History



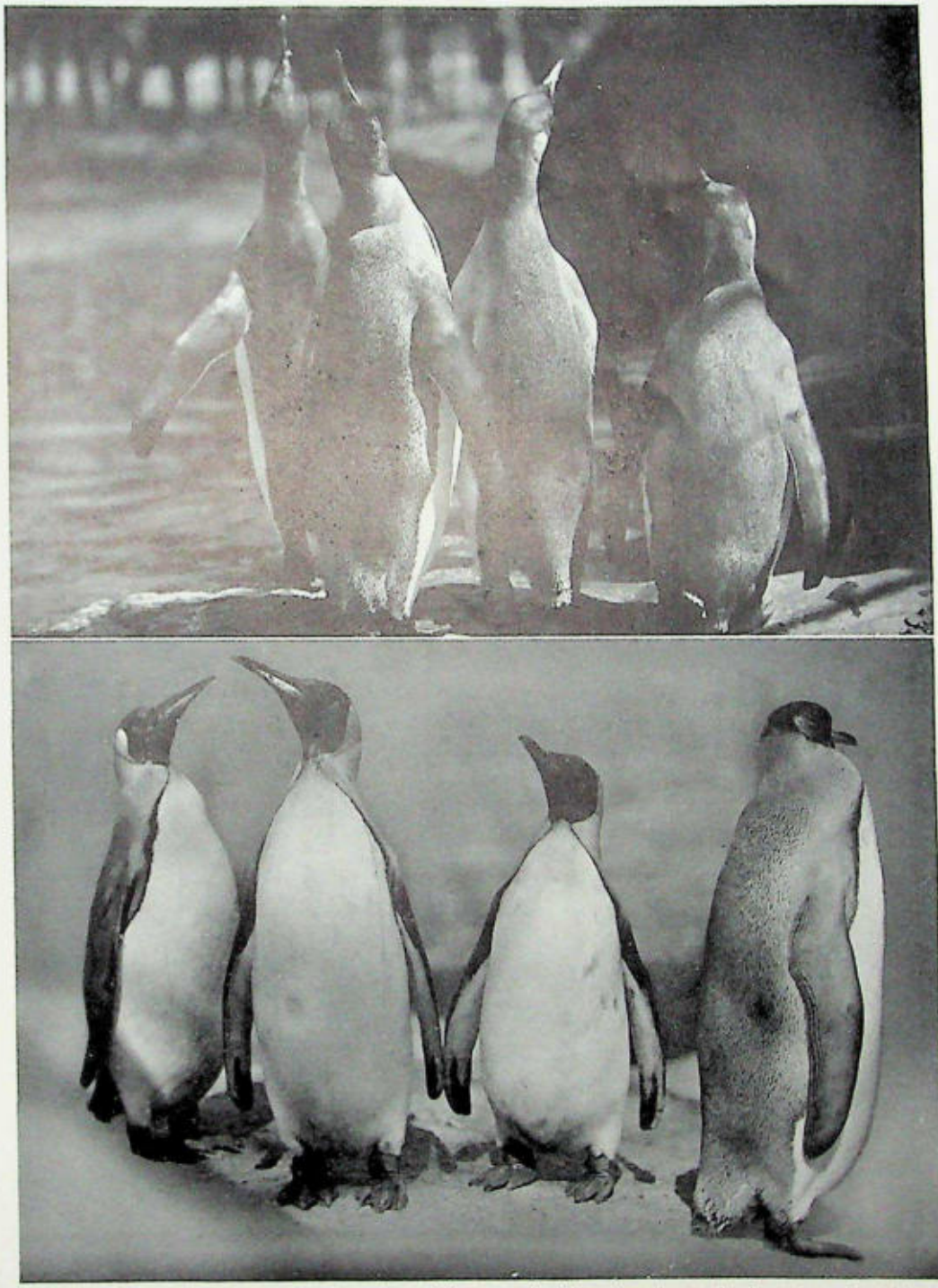
A King Penguin rookery in South Georgia. Conforming to the usual penguin habit, King Penguins are social birds, living in great communities. Even while incubating, they crowd closely together. In spite of this instinctive huddling, each bird is jealous of his rights, and the colony is a scene of constant bickerings. In this species, at least, the specialized wings are not altogether useless when the bird is ashore, for with them he can strike a resounding whack of considerable force.

King Penguins on the march. Unmated penguins form into bands, swimming, feeding and sleeping together. "Follow the leader" is the rule in such troops and where one goes, the others follow.

Photograph, Dr. Robert Cushman Murphy; Courtesy of American Museum, Natural History

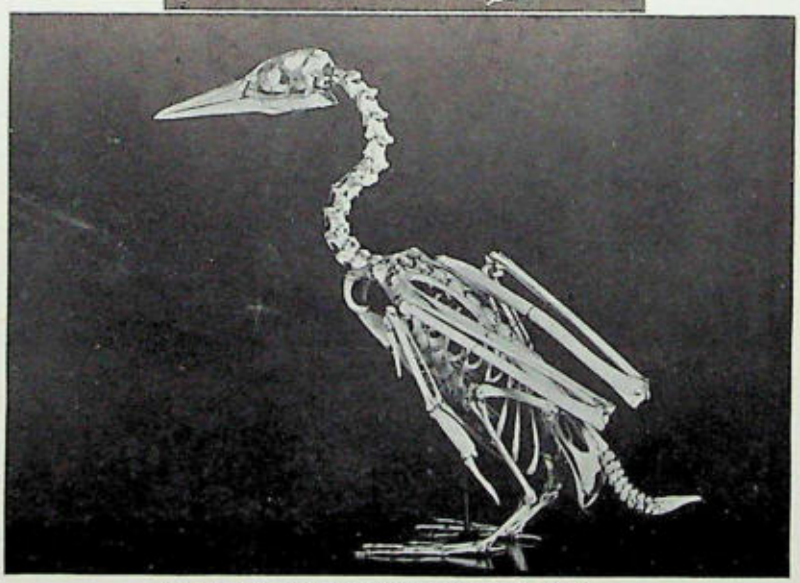
King Penguins in the Zoological Park. In point of beauty, judged by penguin standards, the King Penguin yields only to its great relative, the Emperor. With slate-blue back, snowy breast and brilliant neck-patches of orange, it possesses a really striking beauty.

Photograph, Elwin R. Sanborn



King Penguins in the Zoological Park. When fully erect, the King Penguin stands about three feet high. In stature, he is second amongst the penguins, the Emperor reaching a height of about four feet. Like many other birds whose homes are far from the regular haunts of men, the King Penguin has little fear of people. The ease with which King Penguins may be herded and driven has led to their slaughter in great numbers, at least the more accessible portions of their range.

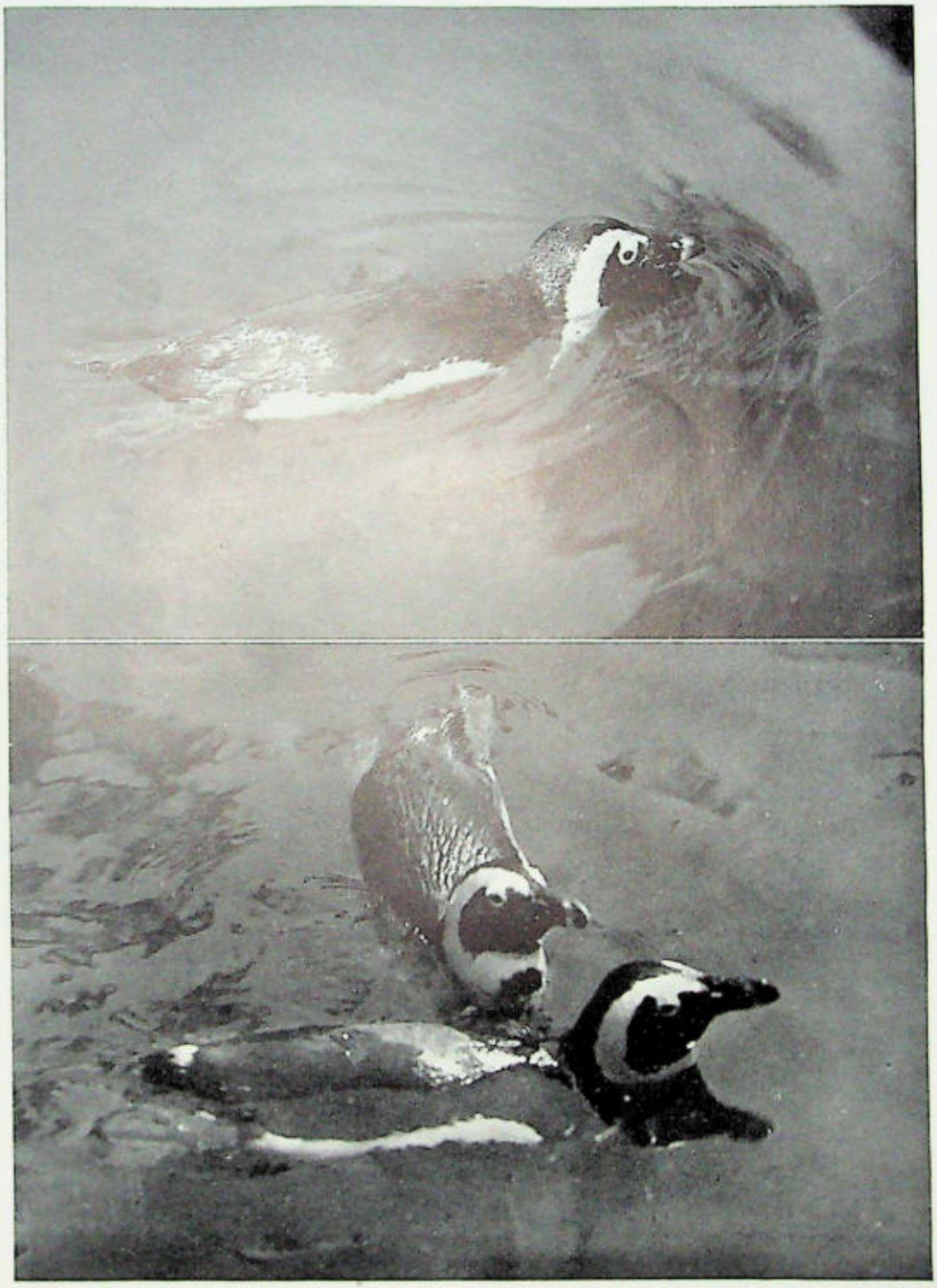
Photographs, Elwin R. Sanborn



Upper: King Penguin (*Aptenodytes patachonicus*).
Lower: Gannet (*Morus bassanus*).

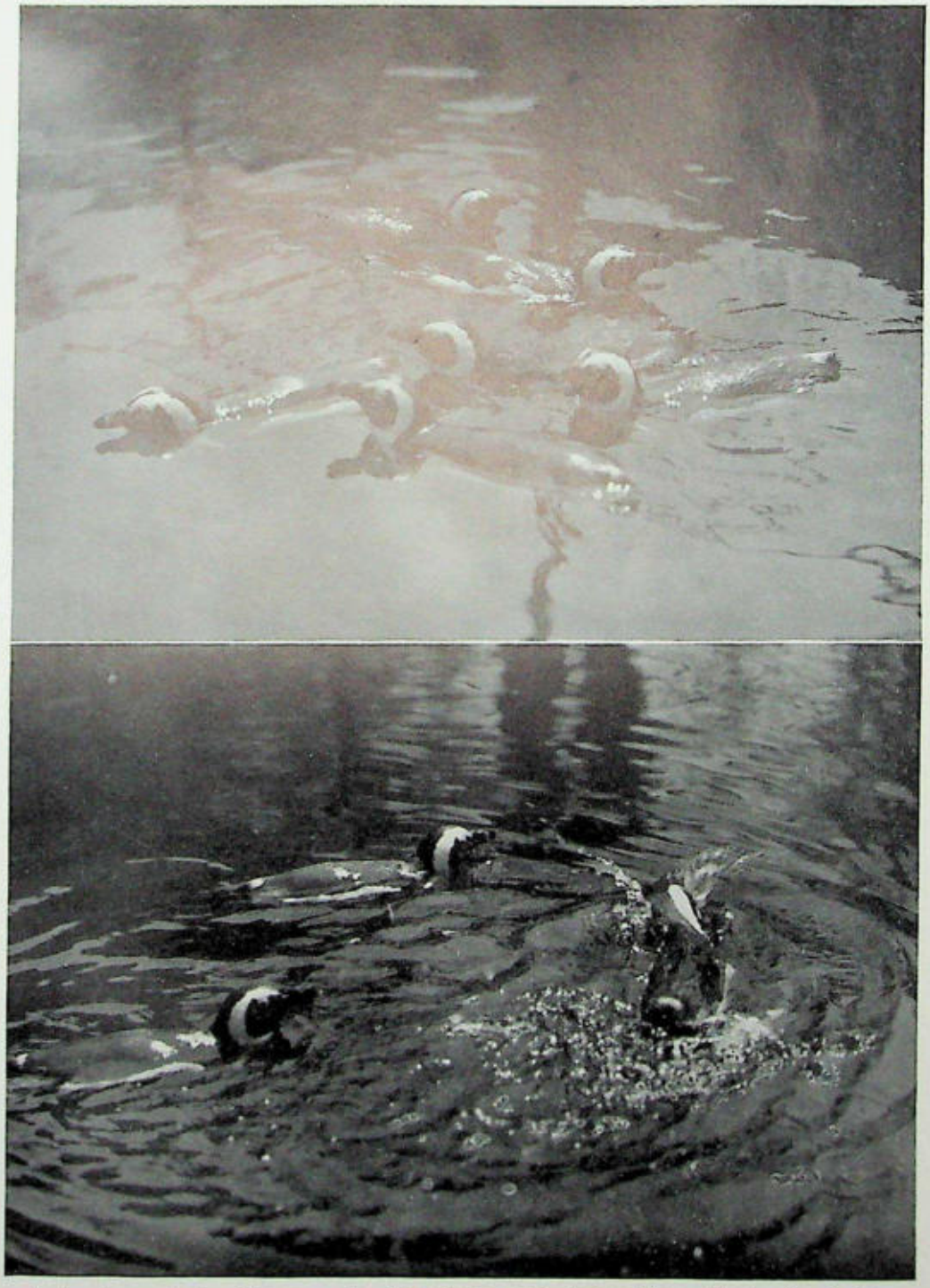
In making a comparison between the skeletal structure of the Gannet, a typical long-winged bird of flight, and that of the King Penguin, we find the most striking difference lies in the bones of the wing. In the gannet, they are long, furnishing support for the great feathers, and the joints are flexible, a necessary feature, of course, for flight. In the penguin, the bones of the wing are short and much compressed. The joints permit almost no movement, although the wing is by no means perfectly rigid, as has often been stated. Also, in the penguin, the bones of the tarso-metatarsus, to which the toes are attached, are entirely free and not fused to form a single bone, as in the gannet and all other known birds, except the penguin. This condition has always been regarded as a primitive character but there seems to be reason to believe that in the penguin the uncoalesced condition of the tarso-metatarsal bones in reality may be an adaptation to the plantigrade habit of the bird.

Skeletons from W. de Witt Miller. Photographs from Dr. Clyde Fisher,
Courtesy American Museum of Natural History



Black-footed Penguins (*Spheniscus demersus*) in the Zoological Park. The Black-footed or Jackass Penguin is found along the coasts of south and southwest Africa. Its local name is a reflection, not on its mentality but rather on its voice, which has some resemblance to that of the animal for which it is named. *Spheniscus* is from the Greek, wedge, and *demersus*, Latin, means diving.

Photographs, Elwin R. Sanborn



A swimming penguin is a sight to remember. While less impressive, because of its smaller size, than the king penguin, the Black-foot is capable of astounding speed and agility in the water. The flipper-like wings moving synchronously, are used in swimming, the feet floating behind, or possibly acting, at times, as a rudder.

Photographs, Elwin R. Sanborn

The Black-footed Penguin is the species most commonly seen in captivity, although of late years it has become very difficult to obtain. It also takes more kindly than other penguins to the conditions imposed upon it. A specimen is still living in the Zoological Gardens of Philadelphia after fourteen years in captivity.

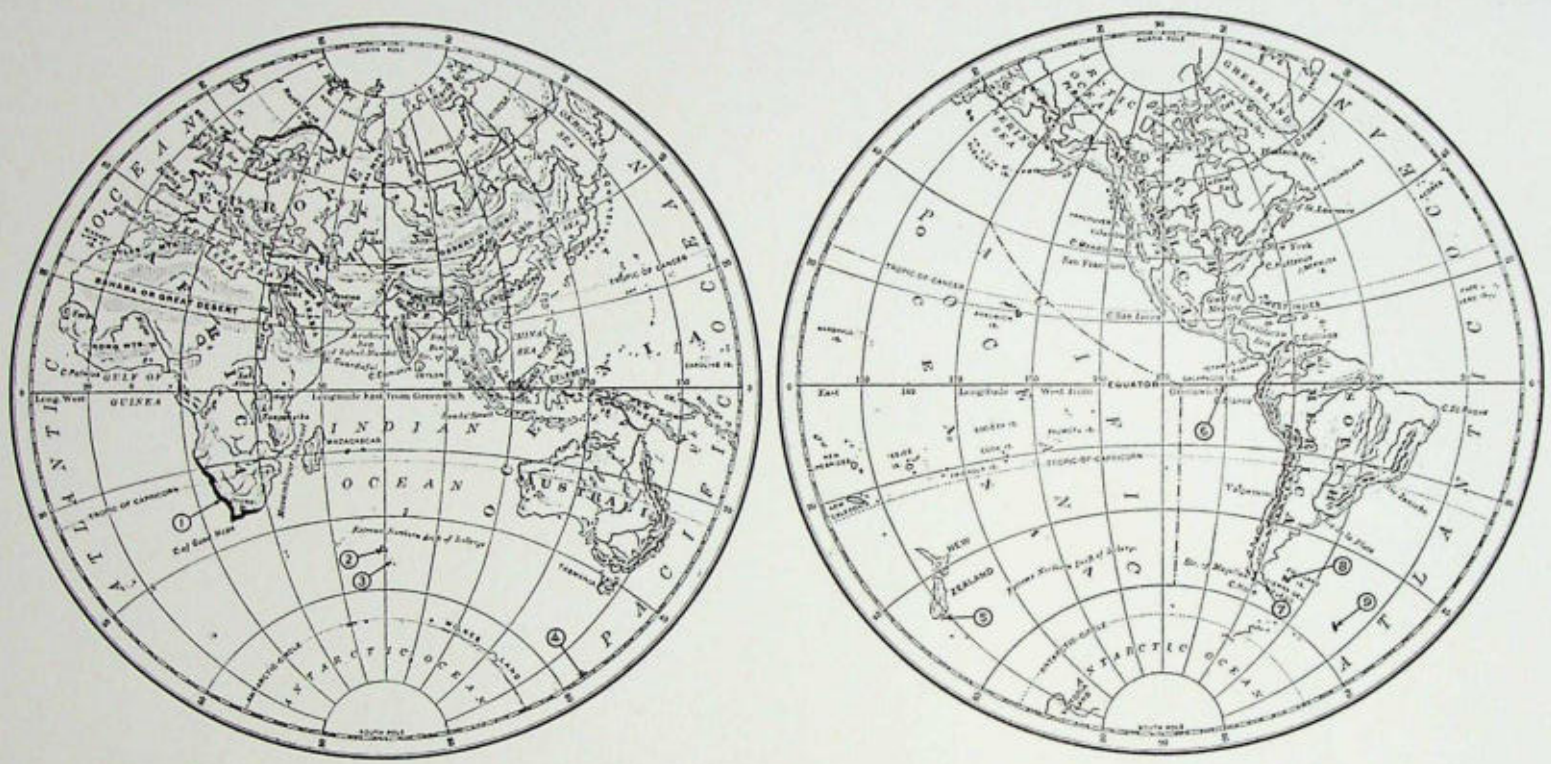
Photograph, Elwin R. Sanborn

Black-footed Penguin and young. The readiness of any species to accommodate itself to the conditions of captivity, is witnessed by its willingness to breed. Black-footed penguins have been reared on several occasions in Europe, but only once in America, as far as we are aware. On May 17, 1915, the first American-born penguin was hatched in the Zoological Park. So earnest was the parents' attachment for the youngster that they fairly fought for the privilege of caring for him. Long after he had become able to look out for himself, they continued to press their attentions upon him.
Photographs, Elwin R. Sanborn

Galapagos Penguins (*Spheniscus mendiculus*) in the Zoological Park. The Galapagos Penguin is one of the smallest of the group, its total length, fully extended, being only about twenty inches. It is the most northern of the penguins in distribution, the Equator passing directly through the Galapagos Archipelago. The Islands are bathed, however, by the cold Humboldt Current, which moves northward from the Antarctic regions, and this doubtless accounts for the presence of the penguins.

Photograph, Elwin R. Sanborn

Galapagos Penguins in the Zoological Park. These Galapagos Penguins, captured by the Arcturus Expedition, under the direction of William Beebe, probably were the first of their kind to be kept in captivity. After their arrival at the Zoological Park, it was found that they seemed unable to thrive in the absence of sea water. Dr. Townsend then offered the hospitality of the Aquarium, where the penguins showed evident satisfaction in the freedom of a great marine pool.
Photographs, John Tee-Van



The Eastern and Western Hemispheres giving the distribution of the four species of Penguins shown in this supplement.

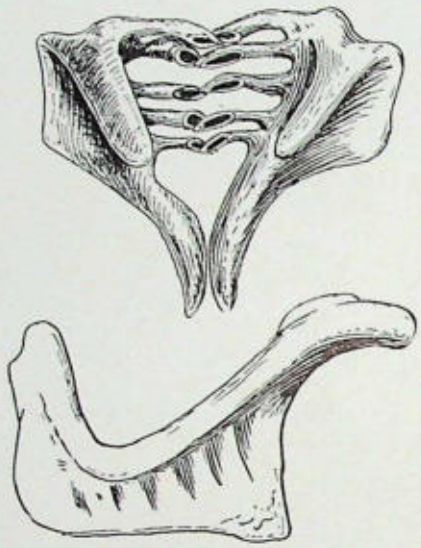
Rock-hopper or Gentoo Penguin (*Pygoscelis papua*) Falkland Islands (8), South Georgia (9), Macquarie Island (4), Heard Island (3), Kerguelin Island (2), and various small islands in New Zealand Seas.

King Penguin (*Aptenodytes patachonicus*) Straits of Magellan (7), Falkland Islands (8), South Georgia (9), Stewart Island (5), Macquarie Island (4), and Kerguelin Island (2).

Black-footed or Jackass Penguin (*Spheniscus demersus*) Coasts of South and Southwest Africa (1).

Galapagos Penguin (*Spheniscus mendiculus*) Galapagos Islands (6).

Prepared by Lee S. Crandall, Curator of Birds, Zoological Park



Pharyngeal teeth of the "bitterling."

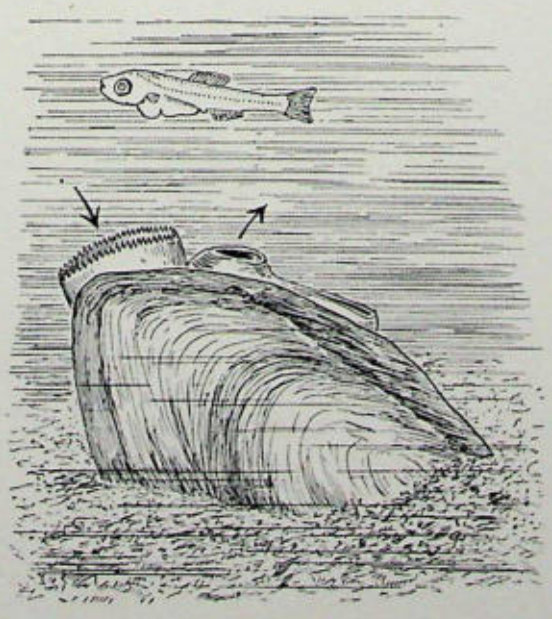
lar heap of warts, white in color and varying in number from eight to twelve, two or three similar growths appear above the rim of the eye sockets. This is a collection of tightly bunched epithelium cells. These protuberances disappear after the spawning season, but they do leave permanent grooves from which, during the next year's spawning period, new warts burst forth.

During the time of spawning, the female remains without any special coloration of its scales. A reddish ovipositor is protruded which is worm-like in appearance and is of almost bodily length. Kessler, in the year 1860, called attention to this tube, but how the eggs were deposited, remained an open question until 1869 when Noll found that the "bitterling" gave the eggs into the care of a *Unio* mussel. When necessary, a different fresh water mussel may be employed by the fish.

Before spawning, the female swims about as if agitated, followed by the male who tries to drive her to a partially protruding mussel. She stands vertical, head downward, and observes the mussel which has been chosen to take care of the progeny. Suddenly she shoots downward, introduces the ovipositor into the excretory siphon of the mussel and deposits the egg. Then the thickened ovipositor is withdrawn and assumes its normal shape. Watchfully the male followed the procedure of the female, it now rushes forward and covers the respiratory siphon with its sperm and so fertilizes the egg. This process is repeated at intervals of a few days.

The excretory organ of the siphon is connected with the respiratory organ, and therefore the egg of the "bitterling" reaches the gills of the mussel. The latter feels that the penetrated egg is a foreign particle and attempts to free itself of it by means of violent contractions. But the smaller mussels are seldom successful in this particular and it is these smaller forms which are chosen by the fish. Within the gill chamber of the mussel, the egg is fertilized, for the sperm enters as far as this point. The cilia of the respiratory siphon which usually grasp the tiny free swimming organisms and bring them, after collecting into a ball, towards the mouth, can not master the minute particles of sperm not only because of their own considerable motion, but also because they attach themselves to the cilia with their long tail. Then, too, they have the property when they once strike an object of clinging closely to it and of penetrating the smallest opening on such objects. They therefore bore themselves through the fine hair sieve of cilias and thus reach the gill cavity where the egg is found which is then fertilized.

The young "bitterlings" which are developed in the gill cavity of the mussel are not parasites, they only take up room but do not take any of the food or juices from the mussel, they only enjoy the protection afforded by their place of concealment until the fish have developed sufficiently to be able to move about. The breeding of the fish makes the mussel uncomfortable in many ways, and, in order not to be driven out



Fresh-water mussel with siphons and young "bitterling." Arrows indicate direction of water flow.

of their safe retreat, the young fish, which hang head downward, are provided with a protuberance at right angles to the head and which, as it goes backward widens into two club shaped excretions on the back. With these, and the protuberance, the young fish attach themselves tightly to the gill chamber of the mussel thus making it impossible for the mussel to dislodge its uninvited guest. As the young "bitterlings" continue to develop, the protuberances and swellings decrease in size. The young fish begins to move its tail in this limited space, and gradually it loosens its hold in the chamber, until, finally, it begins to beat with its fins. This loosens its hold, and the young fish emerges through the excretory organ of the siphon into which the egg had been deposited. The fish, although minute, is fully developed when it is cast into its true element, the water. The development of the egg to the young fish takes about two or three weeks, the exact time depending upon the temperature of the water within the gill chamber of the mussel.

When this interesting and peculiar spawning period of the "bitterling" has passed, the ovipositor shrinks and the male loses its fiery coloring. Life returns to normal for the time of courting has passed.

New Aquariums.—The number of large aquariums throughout the world is steadily increasing. There are twenty-eight at present, fourteen of which have been opened since 1904, five since 1916. Several more are being planned in this country and abroad. The interesting news has lately been received from California that the city of San Diego has purchased an old ship with the purpose of converting it into a combined nautical museum and aquarium. California already has one very fine aquarium in San Francisco and Los Angeles is planning another. Chicago has one aquarium limited to fresh-water exhibits and will have a second, larger one, showing both fresh and salt water specimens. —*I. M. M.*

SWORDFISH EGGS

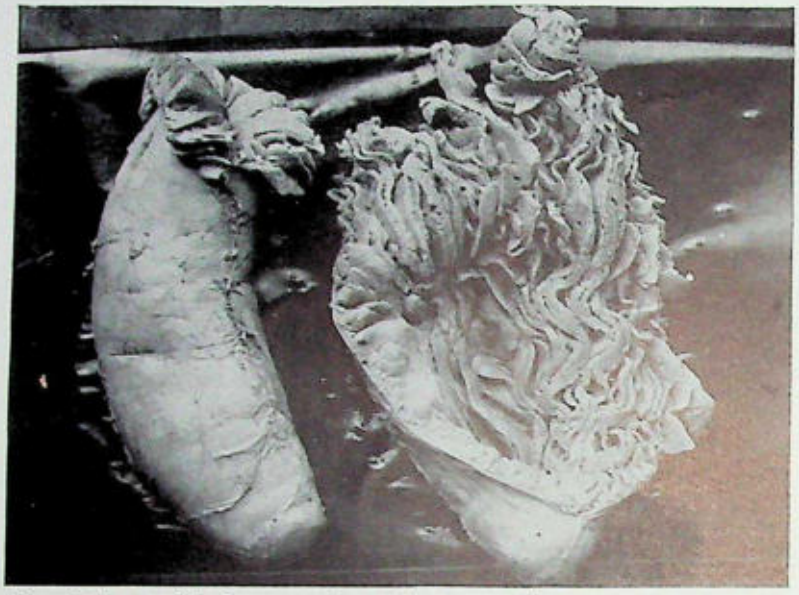
By Marie Poland Fish

ALTHOUGH the adult swordfish is common in our waters, and as a foodfish, has an annual value to New England alone of over half a million dollars ($527,726 in 1924), very little is known of its breeding habits. It is said that the eggs are deposited in large quantities on the coast of Sicily in the latter part of spring and the beginning of summer. Ehrenbaum gives its spawning at this time in the Mediterranean and suggests that it may take place in the open sea as well, but no ripe specimens have ever been seen near the coast of North America. The exact location of the breeding ground of the many swordfish which find their way here, and the time taken for individuals to reach these waters, is a mystery which has not yet been solved.

The finding of a swordfish with partially matured eggs in New England waters is, therefore, of great interest. The catch was made by Frank Janssen of Stonington, Conn., on July 24, 1924, off Cox Ledge, about twenty miles southeast of No Man's Land, Mass., and about 180 miles east of New York City. The fish weighed 150 pounds and contained ovaries of 3.15 pounds. The number of ova was estimated at 16,130,400, measuring from 0.1mm. to 0.55mm. in diameter. Both ovaries were 24cm. in length, one 22cm. and the other 19cm. in circumference at the greatest diameter. The inside was thrown into longitudinal folds on which the eggs were attached, as shown in the accompanying photograph.

There have been, to my knowledge, but two other catches of "green" fish on this side of the Atlantic. Some unrecorded eggs in the Woods Hole collection labeled swordfish eggs, taken from a specimen at Provincetown on September 10, 1909, were further developed and averaged 1.2mm. in diameter. Another fish, taken on June 25, 1922, and landed at New Bedford, had ovaries weighing fifteen ounces which contained immature eggs. This specimen was recorded in the U. S. Bureau of Fisheries Service Bulletin No. 88.

Very few small swordfish have ever been taken in American waters, further evidence that spawning occurs at some distance from these shores. Goode recorded one weighing seventy-five pounds and another fifty pounds when taken, and a third twenty-five pounds when dressed. The last was killed off No Man's Land, in the region where the present specimen was taken. The smallest *Xiphias* ever brought into the Woods Hole market weighed forty-six pounds and measured, including the sword, about five feet. Dr. Bean in 1878 found a sword between one and two inches long in the nostril of a mackerel shark, *Lamna cornubica*, in Gloucester harbor. The fish to which it had belonged could not have been over ten to twelve inches in length. When pulled out, the blood flowed freely, showing that the wound had been inflicted recently. It is impossible to know whether it had occurred in the vicinity, or whether the shark had carried the sword in from



Eggs of the swordfish from a specimen taken twenty miles southeast of No Man's Land, Massachusetts. One ovary partially dissected.

the sea. Although very young swordfish from 10mm. up are taken in the Mediterranean and along the northwest coast of Africa in the eastern Atlantic, the smallest captured near our coast weighed seven and three-eighth pounds. It was taken on Georges Bank by the Schooner *Anna* on Aug. 9, 1922, and recorded by Bigelow. None of these specimens, however, are small enough to throw light on the time and place of breeding.

As there has been no evidence that actual spawning has ever taken place on this coast, we may assume that the present specimen merely remained longer than usual in local waters before leaving for an unknown spawning ground. We may even suppose that these eggs were not intended to ripen this year, but the rarity of fish in this condition indicates it, rather, to be an exceptional case. Were the eggs carried for more than one season, we would expect to find "green" females in far greater numbers.

BEAVERS IN INTERSTATE PARK

Extracts from a letter by William A. Welch, General Manager, dated October 11, 1926

THERE are at present nineteen beaver houses in the Park and four in areas outside the Park, all of which are occupied. The locations of these habitations and the approximate areas flooded by beavers are as follows:

"In Beechy Bottom, one lake containing two houses, which floods approximately five acres; one dam and house in a small pond about 50 feet wide and 200 feet long. In Bockey Swamp there are a dam and a house and about ten acres of swamp land flooded; one dam and house, with about one acre flooded and a house in Lake Nawauhunta. The beavers are now engaged in damming the outlet of this lake.

"On Tiorati Brook there are two dams, one flooding about five acres, the other about two acres, in each of which is a house. Pine Swamp, which is one of the heads of Stony Brook, has two dams, flooding respectively two acres and one acre, with a house in each.

"At Beaver Pond there are a dam and a house and about an acre of timbered swamp flooded. On Stony Brook and one of its small tributaries, there are six dams, each with a house, which flood a total of about twenty acres, part of which is timbered. On Popolopen Creek there are two dams and houses and a total area of about nine acres flooded.

"Outside of the Park, on the west side of Crow Nest Mountain, in the water supply of Cornwall Village, there are a dam and a house. At Sterling Lake, west of Tuxedo, a dam and a house, and just back of Stony Point, on one of the tributaries of Tiorati Brook, a dam and a house. There is one colony, and possibly more, down in the Saddle River country in Northern New Jersey, which evidently came from the beaver in this Park.

"The beaver ponds in Beechy Bottom are being used extensively by wild ducks, both Mallards and Black; the areas in Beechy Bottom are used by Mallards and Black Duck as breeding grounds; the areas on Stony Brook are used very extensively by Wood Duck, there being more than 200 Wood Duck in these lakes. The areas on Cedar Pond Brook (Tiorati Brook) are also used as breeding grounds by both Mallards and Black Duck. The areas in Pine Swamp are used by Mallards and Wood Duck. The open areas on Stony Brook, which are flooded, are used as feeding grounds by the Wood Duck.

Beaver house in Palisades Interstate Park. Published by courtesy of the Palisades Park Commission.

Beaver house in Palisades Interstate Park. Published by courtesy of the Palisades Park Commission.

Beaver dam in Palisades Interstate Park. Published by courtesy of the Palisades Park Commission.

Forest flooded by beaver operations and now frequented by wood ducks. Published by courtesy of the Palisades Park Commission.

"I have just discovered something which I mean to photograph, which, to me, is particularly interesting. I have long wondered why the beaver's tail was shaped as it is and have heard many theories as to its use, none of which seemed to solve the puzzle. I was only sure of one thing, that he does use it to signal other beaver of danger just as the Antelope uses the white hair on his rump for this purpose but, of course, this did not warrant Nature in putting such a tail on this animal.

"The other evening I watched at Nawauhunta a beaver come to the shore of the lake and with his teeth and his front feet dig out about an ordinary spade full of mud and grass roots from the edge of the bank. He drew this mud and grass roots out into the lake where it was just covered with water and then turned around and put his tail under the whole thing, just as you would a spoon, bent up the end of his tail to hold it on and swam about twenty-five yards with this shovel-full of mud on his tail, over to the dam, and placed it on the dam. He then drew his tail from under it, turned around and started to put it into shape.

"I hardly like to tell that story until I can get a picture that will actually illustrate it because I have never heard of anything of the kind before and would prefer to have additional evidence that they do use the tail as a mud scow."

STRIPED BASS (*R. lineatus*)

A Study of Weights and Lengths as Compared With Ages

By R. H. Corson

AN orderly arrangement in graphic form of data collected by members of the Asbury Park (N. J.) Fishing and Gunning Club in 1924 in connection with work taken up by the Committee on Cooperation with the Bureau of Fisheries, of the Association of Surf Angling Clubs, discloses some striking features regarding the growth of that highly prized food and sporting fish, the striped bass, *Roccus lineatus*.

While the bureau has done considerable work on this fish in the first, second and third years of life, it has published little or nothing beyond those periods. All the material from which the present paper is drawn was divided with the Bureau and is on file there awaiting study. As this paper is based on age determinations by scale reading made independently of the Bureau, that careful and capable agency must not be held accountable for errors which may be proved to exist herein. The responsibility therefor will belong solely to the writer.

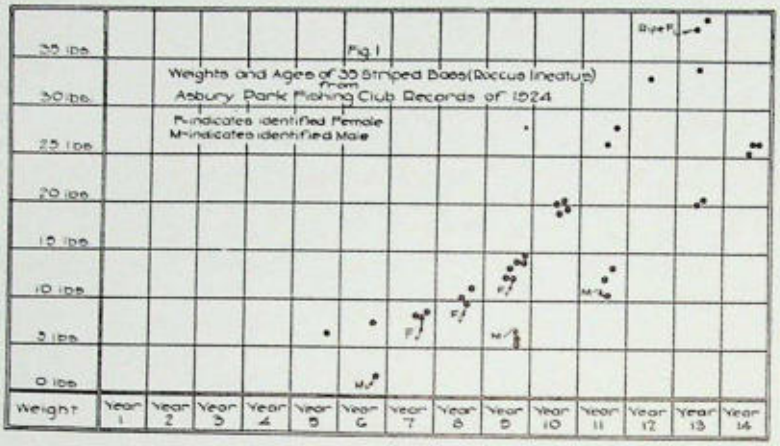
At the opening of the surf fishing season of 1924, the members of the club were requested to take samples of the scales of their fish and turn them in with records of weight, length, sex and date of capture. Out of about one hundred of the specimens taken between May 10 and October 31, the data on thirty-five were complete enough to be studied.

The earliest entry was made on June 14 and covered the thirty-eight pound 9 ounce ripe female appearing in the thirteenth year. The lengths recorded are total as it is difficult for anglers to confine themselves to standard lengths.

The accompanying graphs express weight and length vertically and time horizontally, each year conforming to the human calendar. As the bass spawn in New Jersey waters late in May or in June, it, therefore, follows that, as the graphs are drawn, the first year covers but six or seven months of the life of the specimen and, for further example, the fish placed in the fourteenth year are thirteen years and a few months of age.

In pursuing the study, the age determination was made from the annular rings on the scales and the individuals listed by years in the order of their capture. These notes were then transferred to the graphic charts for greater clarity of expression, and the striking disclosure at once appeared that there were two distinct curves in both length and weight. All the identified females, four in number, fell in the upper curve and all of the identified males in the lower. In one or two instances divergences from the average of a year class were noted, but in each such case a careful restudy of the scales revealed an error in the first age determination, which when corrected, brought individual closely in line with the whole series.

Attention is called to the three heavy fish in the thirteenth year, weighing, respectively, thirty-eight and a half, thirty-four and thirty-nine and a half pounds. The first was the ripe female above referred to, taken on June 14 just above Barnegat Inlet. The roes were soft —ova dripping from the genital pore, and were estimated to weigh between five and six pounds. This is the only instance coming to the attention of the writer during seventeen seasons of surf fishing in which a ripe bass has taken the hook and the occurrence is believed to be exceedingly rare. The second fish, taken about a week later, was five and a half pounds lighter although of approximately the same length. Although unidentified as to sex the latter was undoubtedly a spent



fish, for had it been heavy with roe as was the other, the fact would very probably have forced itself upon its captor. Thus the suggestion is that the marked difference in weight is to be accounted for as a loss due to the extrusion of ova.

Coming now to the last of the trio, the thirty-nine and a half pound high hook fish of the season, taken on August 2, we have a specimen which has progressed about six weeks into the feeding after suffering a loss of weight approximating that just disclosed, and as a result, has put on sufficient to offset the loss. With three or four months good feeding ahead, it may be surmised that she would have weighed forty-eight or fifty pounds on going into winter quarters had she not taken the hook.

Although there is no such pronounced downward sweep in weight exhibited in other years for the reason that no other ripe fish appear, the suggestion of an upward sweep in weight is present in several year classes.

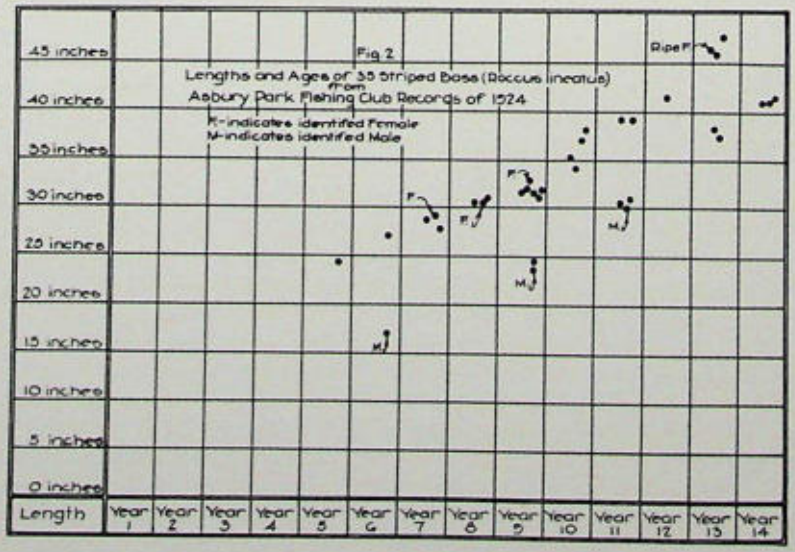
With a distinct curve in both length and weight* in each sex thus so strongly indicated, it becomes probable that unless sex be fully taken into account in studies of growth rates in fishes, the resulting picture will present great confusion and prevent a clear recognition of all the bearings of the process.

While the examples exhibit a preponderance of females slightly over two to one, the evidence is not sufficient to support a belief that the proportion holds for the species as a whole. Possibly it may hold for the particular locality fished; namely, the New Jersey surf between Long Branch and Barnegat Inlet. As the fish depart from their spawning grounds and proceed to sea, a gradual segregation of the sexes may occur which has not progressed very far in the surf of the mainland. At a considerable distance it may be complete. In support of this hypothesis the writer has forwarded data to the Bureau of Fisheries on thirteen fish taken with rod and reel by Mr. C. B. Church on the famous Cuttyhunk bass grounds. These fish ranged from thirteen to fifty-four pounds and were all spent females. It may well be that Cuttyhunk's reputation for large bass rests wholly upon its being a summer resort for the females of the species—an Adamless Eden.

Passing still further from the realm of fact into fascinating fields of speculation, the weight curve of the females may be projected upward and onward to about the twentieth year where it is found to cross the 107-pound mark, at which weight, if memory serves, the Bureau records a Susquehanna River female bass.

The writer's thanks are due to C. M. Breder, Jr., for his encouragement and active aid.

* Attention is called to the fact that the female curve indicated in the second graph is slightly convex downward, which is understood to be unusual.



HOW FISHES SWIM[1]

By C. M. Breder, Jr.

EVEN the proverbial small boy knows that when the average type of fish wags its tail it moves forward. However, the exact manner in which this effort operates to produce the visible effect is not particularly patent in all cases. It seems, on the face of it, to be a far cry from the elongate and sinuous eel to such forms as the short and firmly incased trunkfish. Nevertheless there is a fundamental similarity between even these two extremes and the more common types of fishes in matters of locomotor methods.

At present the movements of the body and tail fin only are being considered, a discussion of the functions of the other appendages being reserved until later. In order to gain an understanding of these movements and the manner in which they are produced and act we must know a little of the structures of fishes directly concerned with swimming. Every one who has "dissected" a cooked fish at his dinner is familiar with the anatomical parts which concern us at this time. Supporting the body of the fish is the familiar backbone, a series of small jointed pieces which make it, as a whole, a rod flexible from side to side but quite rigid vertically. This forms the foundation which at once gives the fish sufficient rigidity and permits of the necessary amount of flexibility. Surrounding the backbone and its various stays and braces are great masses of muscle tissue which extend from the base of the skull to the tail fin and are interrupted only by the relatively small visceral cavity which contains the vital organs. These muscles are arranged in a series of segments and are those flakes which fall away under the pressure of the fork. They are the swimming muscles which flex the body from side to side. Their attachment is such that the contraction of any one or series of adjacent ones on a side so shortens it as to curve the body to that side while corresponding muscles of the opposite side proportionally relax.

With these conditions in mind let us consider the eel. A few of the anterior segments are contracted first on one side, forming a wave in the elongate body just back of the head. This wave is then passed backward by successive contractions and relaxations of the serial segments of that side until the tail is reached. Immediately following on the other side a similar but opposite wave is initiated and so on progressively resulting in the passage of a continual series of waves backward over the body of a swimming eel not unlike those to be seen in a rippling flag. Each of these waves has a diagonally backward pressure and as they alternate from side to side the total effect urges the eel directly forward.

In the case of the trunkfish, which is encased in an actual shell so that no body movement is possible, the tail projects from a hole in it in such a manner that little more than a simple side to side flapping is possible. Such movements are not dissimilar to those employed in the sculling of a boat except that there is not the twisting of the blade as commonly employed in sculling which has to do with the boat's position on top of the water and other reasons that cannot be gone into here.[2]

We have now briefly considered the two extremes of body and tail movement in fishes and are ready to discuss the more ordinary type, as seen in the goldfish, trout or weakfish. Apparently such species subscribe to neither of the above methods and superficially the movement appears to be quite different. Bearing in mind that the movements are produced by the same sort of serial contractions of the muscle segments such movement may be truly considered as intermediate between the two and the entire locomotor body movements of fishes to be a complete series with the elongate eel at one end and the abbreviate trunkfish at the other with the remainder of the fishes using body contortions for locomotor purposes falling between them in proportional places, dependent upon their length and flexibility. In other words, whether a tail will have a simple flapping motion or the whole body a somewhat serpentine one is largely dependent on the number of segments of the backbone and lateral muscles involved and the accompanying flexibility of the body. A simple mechanical analogy may be made that will illustrate the point. An ordinary stiff fan, a piece of slightly flexible cardboard and a piece of ribbon may be taken to represent the three types just discussed. Any one of these held in the hand and given a reciprocal motion when held at one end, that is, a fanning motion, will represent an approximation of the movements of these three types which are all induced by similar movements in differently constructed bodies.

Further than this we cannot go here but must pass on to a consideration of movements of the

[1] This article is based on "The Locomotion of Fishes." Zoologica Vol. 4 No. 5. C. M. Breder, Jr., which was awarded the A. Cressy Morrison prize in 1925 by the New York Academy of Sciences.

[2] These effects are discussed in full in the original paper on which the present is based.

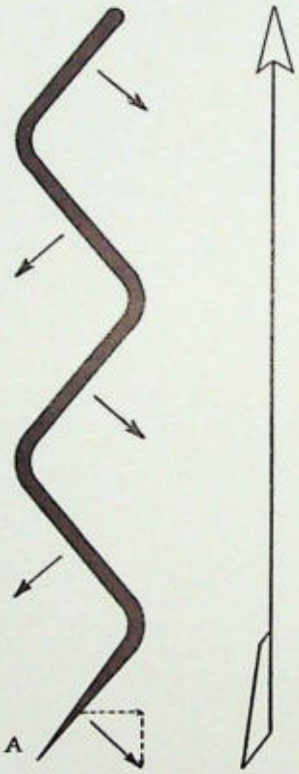
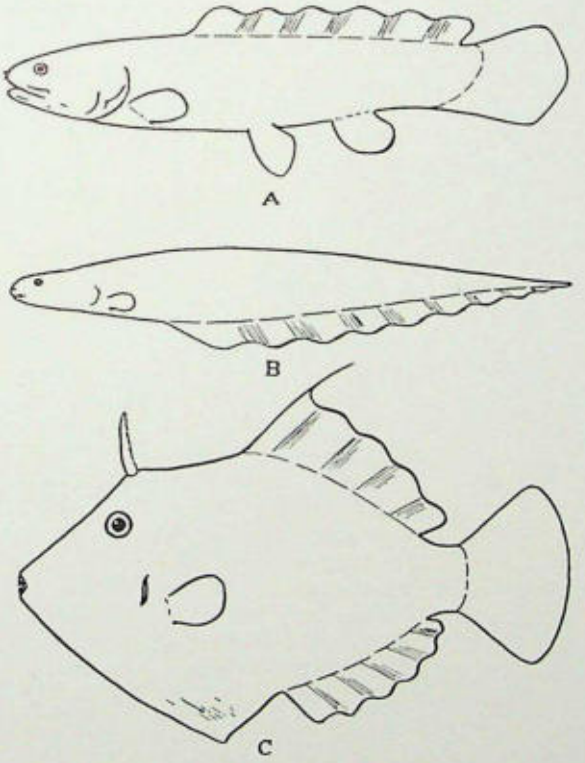
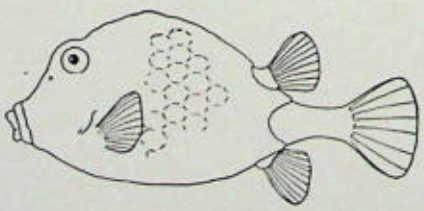


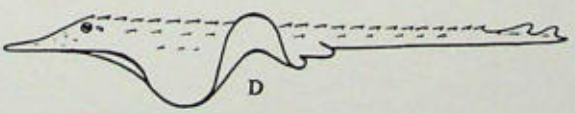
Diagram of the forces at play in the swimming of an eel. The short arrows indicate the direction of pressure from the backwardly moving waves. The long feathered arrow indicates the direction of travel.

The movement of an eel compared with that of a jack indicating the basic similarity.





A trunkfish showing the rigidly encased body.



Four types of fishes employing movements of the appendages for locomotion effect. A, bowfin (dorsal undulation); B, gymnotus (anal undulation); C, file fish (dorsal and anal undulation, diagonally opposed); D, skate (pectoral undulation).

fins for propulsive purposes. This use of them is not to be confused with their use as maneuvering organs. Whilst nearly all fishes are capable of propelling themselves by some movements of the body, many habitually use certain fins and resort to the more primitive body efforts only at times of great fright or when there are other demands for unusual exertion.

The accompanying figure shows four diverse types of fishes which commonly employ undulations of vertical structures for propulsive purposes. Those shown illustrate movements in the fins of what may be considered as localizations of the eel-like movement. Instead of the lateral body segments operating, muscles attached to the base of the fins rays wave them in such a manner that the fins as a whole undulate in a very similar manner to the body of an eel. However, there are others which show similar localizations of the flapping movement and the intermediates. The smooth puffer, frequently to be seen at the Aquarium, is a good example of a type using the dorsal and anal fins as flapping propellors.

Still other fishes have the pectoral fins (those located on the side, just behind the head) modi-

fied for propulsive purposes. These, too, run through a similar gamut of variation only changed far enough to suit the placement of the appendages so far forward. Thus the flapping type of pectorals may be considered as two forwardly displaced and opposed tails of that nature, and so on.

Finally we find that throughout this highly diversified assemblage of vertebrates known as fishes there runs a distinct thread of similarity in regard to locomotor methods only modified by the particular organization of each specific requirement and usually of a nature not directly concerned with locomotion.

We may now consider the only other locomotor effort employed by fishes in swimming. As is well known, fishes, in respiring, take water in at the mouth and expel it through the backwardly directed gill clefts. Given a little thought it becomes clear that this pumping of water in and out in a single direction must have some reactive effect tending to drive the fish forward.[3] It remains then merely a question of how effective such streams are and of what significance to the swimming of fishes.

It is somewhat a source of chagrin to me to have to admit that it was a mechanical engineer and not a brother naturalist who called my attention to this locomotor element. Mr. Clifford M. Paxton, working on an improved method for propelling ships, invented at once simple and ingenious device, the principles of which are based, not on a study of fishes, as they might have been, but on a study of abstract physical principles. This is no place to launch on a discussion of abstruse physical principles concerning hydraulics and hydrostatics and it will have to suffice to say that Paxton's original vessel, a model destroyer of 40 feet in length, performed according to his calculations and that he is now engaged in organizing his forces for the commercial exploitation of his discoveries. Indeed, it has been suggested by persons better qualified to judge than the writer that the death knell of the screw propellor for fast economic service may be sounding even now.

Basically in his method of propulsion Paxton provides for taking water in by means of high speed pumps and ejecting it through two very narrow and backwardly directed slits, one on either side of the hull. These are placed about where the gill clefts of speedy fishes are located. The sheets of water so ejected sheath the hull and induce a flow in the surrounding water so that the bow wave (that quantity of water "piled up" about the bow of an ordinary speeding vessel) and the cavitation at the stern (that hollow which is due to the sluggishness of water to fill the space out of which the hull moves) are entirely eliminated. With these elements of resistance overcome, which are actually the chief obstacles to speed, it requires a very slight thrust to move the boat forward, which is amply provided for by the excess force of the jets.

Bearing on this is the fact that high speed fishes are invariably equipped with long narrow gill clefts very similar to those used by Paxton in his mechanical device and whatever may be the significance to such fishes it seems certain that they operate according to the factors discovered by Paxton. The precise effect is yet to be studied in such forms. In low speed fishes the gill openings are not such deep narrow slits and are not infrequently nearly circular and less tangental to the surface of the fish's body. Here simple nozzle reaction plays a relatively larger part, but the effect of the jets may be readily detected. Such a fish as the spiny boxfish, if held in the hand near the surface of the water, will eject streams of water through the gill openings with such force that they may reach a height of three feet or more. Thus again we have a series extending from the high speed fishes in which the factors of Paxton are significant to those of slowest speed in which simple nozzle reaction is of relatively more importance. It is to be noted, however, that the exhalations of fishes are intermittent and therefore can not be as efficient as in a similar mechanical device with continuous "exhalation."

Now, in a very sketchy way we have covered all known methods used by fishes in producing straight forward horizontal movement through open water. A discussion of the specializations of fishes adapted to burrowing, creeping, leaping, flying and so on, each ability of which is limited to a minor number of species, would make another story. Maneuvering, that is, turning, rising, falling, starting, stopping and so on for a large part consists of differential application of the locomotor apparatus. It, too, would make another story which might include such topics as the functioning of the swimbladder, the maintenance of a stationary position when the effects of the respiration must be offset and so on. The relationship of habits and development, the modification of the smaller parts, such as scales, the interpretation of the locomotion of fossil fishes and so on are all borne upon by the main theme but we are con-

[3] The mechanics of the pumping device which effects this is described in an article in the BULLETIN for May, 1925 (Vol. XXVIII, No. 3) entitled "Fishes Squirting Water" by the present writer.

fining ourselves in the present discussion to a very brief consideration of the simple efforts of producing progressional movements ordinarily referred to as swimming and may conclude with a tabulation of the methods illustrative of the fundamental uniformity found throughout.

Direct muscular efforts.

1—Body movements (including the tail fin) eel-like to typical to trunk-fish like.

2—Fin movements.

a—Longitudinal fin movements (dorsal, anal and pectorals of skates). Localized body movements.

b—Paired fin movements (pectoral fins, except skates). Localized body movements.

Respiratory efforts.

1—Exhalant streams. Paxton's factor to intermediate to nozzle reaction.

AT THE AQUARIUM

Burgess Johnson in Harpers Magazine

Fishes swimming in and out
Till my eyes grow dizzy.
What's the task that you're about,
Keeping you so busy?

Are you meant, as people say,
Just to throw a hook at—
Or be brought from far away
For us all to look at?

Dogs and horses know my words,
Cats are warm and homey;
Cows and mice and even birds
Sometimes get to know me.

Yet you stare with not a wink,
Seeming not to see me.
Are there thoughts we both can think—
Something strange and dreamy?

I may puzzle you as much!
And I wonder whether
When I see your noses touch
You all talk together?

There's another world, it seems,
That you drift and dart in,
Full of ways and deeds and dreams
I can have no part in.

Painted turtles frequenting the roads in large numbers near Minneapolis. From a photograph by Major Chapman Grant.

AUTOIST SPARE THAT TURTLE

MAJOR CHAPMAN GRANT, U. S. Army, formerly of the Aquarium staff, sends the following interesting letter relative to the destruction of turtles by automobiles. He observed large numbers of turtles near Minneapolis, crossing the roads in June, all being females seeking suitable ground in which to deposit their eggs. Similar conditions were noted in the vicinity of Wichita, Kansas. The useful turtles and tortoises are evidently suffering at the hands of the autoist, who might avoid killing them if he cared to do so.—*C. H. T.*

"The hare is having the last laugh these days. The tortoise methodically crossing the road is too often flattened by the careering flivver. In touring through the central states the most frequent auto casualties observed are the English sparrow, the red-headed woodpecker and the turtle. The wily sparrow succumbs because of his extreme abundance—any rapidly moving object is likely to hit one. The red head is attracted to the telephone pole as a suitable perch, whence he tries to salvage bewildered bugs from the wake of autos and being a clumsy flier he does not escape the next car.

"There is one turtle death trap in particular that has evoked newspaper comment. It is a stretch of parkway between two lakes in Minneapolis. The particularly lethal part of this roadway is the curbing. The traveling turtle falls off the near curb, tries to climb the further one, finds himself trapped, loses his poise and starts scuttling back and forth until pancaked by the passing car. The painted turtle and the snapper were the only sufferers here, in the proportion of about thirty to one.

"On one occasion I saw a dog pick a turtle from the roadway, trot onto the grass and drop him. The occupants of my car considered that dog the most kind hearted they had ever seen. I did not tell them that he would have shown the same solicitude for an old shoe.

"When not pressed for time I salvaged dozens of them—primarily because I wanted to study their variations in markings and coloring.

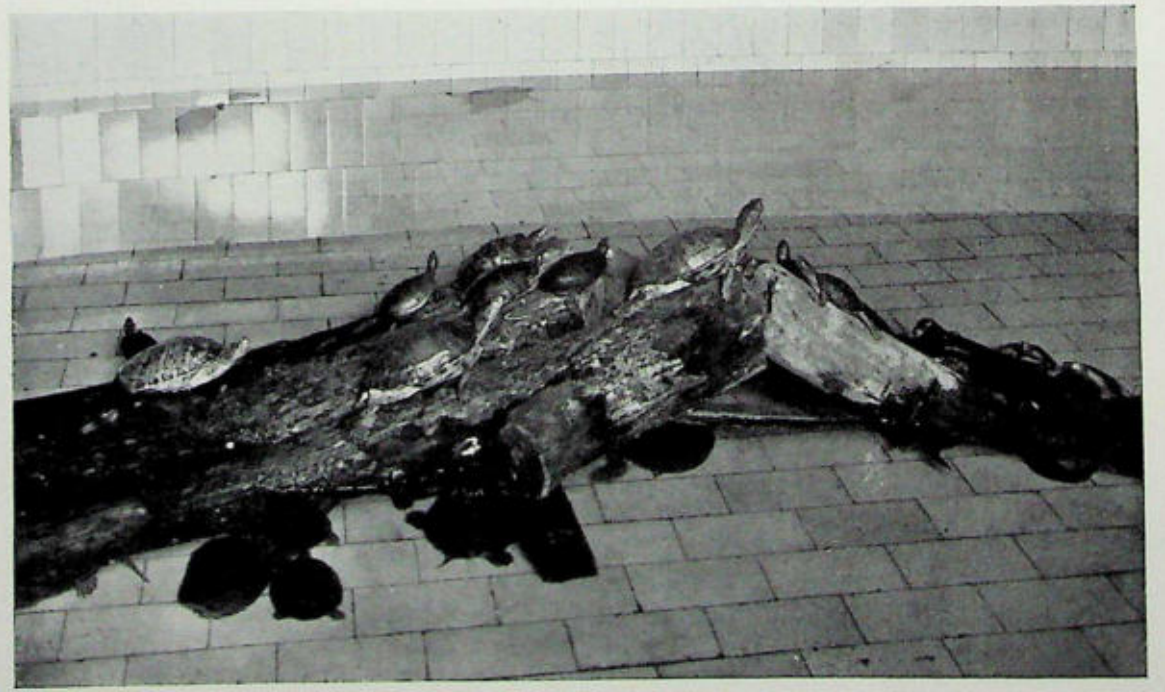
"South of Wichita a two-mile strip of pavement skirts a stream. One September day I counted two hundred casualties, more or less, on this strip. Painted turtles and yellow-bellied sliders predominated, with snappers of assorted sizes a poor third. An occasional box tortoise had offered himself to Moloch. Mud turtles (Kinosternon) were conspicuous by their absence. They are numerous in the rivers and apparently intend to remain so.

"The box tortoise seems to have centers of abundance or routes of travels in Kansas. I have not yet determined why they are so numerous in certain restricted areas. They are frequently to be seen on the roadside eating apple cores or melon rinds. Their favorite food seems to be evil smelling Carabid beetles. They ignore nice fat June bugs, but are very fond of raw meat of any kind or caterpillers, fuzzy or smooth.

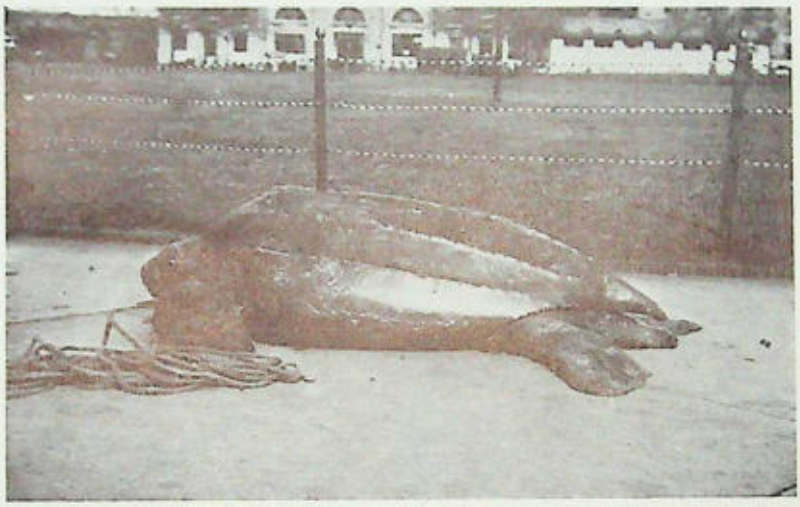
"I have a few sample turtles in a pen for study. I was surprised to find that the water-loving mud turtle would eat meat on dry land whereas the painted and sliders refused except under water.

"The box tortoises in the neighborhood of the city for the most part bear scars of their feud with autos. The most frequent disfigurement is a broken hinge. They seem to have great power of recuperation. I have seen a passing auto run over the edge of a box tortoise and catapult him many feet.

"Snakes suffer a higher percentage of mortality because they are easier to hit and should they be missed, the autoist descends and under a misguided sense of duty kills the snake."



Turtles drying off in one of the fresh-water floor-pools of the New York Aquarium. From flashlight photograph by Morris Rosenfeld.



Leatherback turtle which lived for several weeks at the New York Aquarium in 1908. It weighed 840 pounds and supposedly was the largest ever exhibited.

ITEMS OF INTEREST

By C. H. Townsend

Transporting Live Fishes.—The transportation of live fishes is not difficult when they are carried in large containers with a plentiful supply of their natural element, so arranged that it can be mechanically aerated.

Their transportation in small containers, to be aerated by hand with dippers, is practicable for short distances only. By either method, the fishes give off quantities of slime which eventually fouls the water.

When the Steinhart Aquarium in San Francisco sent live fishes to New York in small tanks in September of the present year, we predicted the loss of the fishes, although the water was aerated by the use of oxygen supplied slowly to each tank. The slime constantly floating to the surface was skimmed off frequently but the fishes perished before Chicago was reached.

On the return trip the messenger, Mr. R. J. Lanier, left the New York Aquarium with seventy-six fishes, the tanks being supplied with oxygen as before, but with the addition of a filter, the value of which he seems to have demonstrated. Sixty-eight of the fishes reached destination alive. As the water became slimy, the supply in the tanks was filtered in turn and kept fairly clear. The fishes being marine species carried in sea-water, a change of water was not practicable. An extra supply of sea-water would, of course, have been helpful, but this was also impracticable, the facilities of a baggage-car being limited.

Mr. Lanier, formerly an employe of the New York Aquarium, deserves credit for demonstrating that fishes can be carried three thousand miles in a baggage-car. He got but twelve hours of sleep during the four days' trip. A small hand or electric pump would have saved much of the labor of bailing water in filtering, but he has shown that fishes can be carried in this way provided they are accompanied by a messenger who is willing to get along with the minimum of sleep.

The trip eastward was arranged through the courtesy of the Baggage Department of the Southern Pacific Railroad, the westward through similar courtesies extended by the Pennsylvania Railroad. The tanks were carried free, the messenger purchasing full fare tickets each way.

The Size of the Leatherback Turtle.—The large sea turtle (*Sphargis coriacea*) which died in the Aquarium several years ago, weighed, after death, 840 pounds. This turtle, now mounted, has been considered the largest specimen of its kind actually weighed in the flesh, but it had lived several weeks in the Aquarium without feeding and probably lost weight. The carapace measured—curved length—five feet and one inch.

The California Academy of Sciences has recently acquired a leather back turtle, taken off Santa Cruz Light House, California, which weighed when captured 1,286 pounds. The length of carapace — curved — is five feet and three inches.

There is no larger example of any species of sea turtle to be found in museums anywhere so far as can be ascertained.

Fishermen along the New Jersey coast notify the Aquarium nearly every summer of the capture of leather backs of enormous size but none have approached the above records of weight when placed on the scales.

An Old Tortoise.—A Box tortoise from Kings Park, Long Island, recently received at the Aquarium, bears on its under shell the date 1878. The figures originally cut rather deeply, are dim and apparently very old. The tortoise must have been an adult when marked, as the figures are of half-inch size. If the date is genuine this tortoise must be considerably

more than fifty years old. The writer cut dates and his initials on some box tortoises in Pennsylvania when a boy, one of which was returned to him twenty years later.

The box tortoise and other dry land tortoises do not thrive in the Aquarium, and it would be better for them if the kindly disposed persons who send them in, left them in the dry woodlands and sunny fields where they belong. Such tortoises are retained in the Aquarium only a few months. When they cease to feed or show signs of ailment they are sent to suitable places in the country and liberated.

The Aquarium recently set free a surplus of box tortoises in a secluded field among the hills of the Interstate Park.

Fish from Detroit.—An exchange of specimens with the Detroit Aquarium on October 1st brought to New York numerous fishes from the Great Lakes, including gar, muskallunge, fresh-water drum, lake sturgeon and lake trout.

A Shark-Sucker Taken with Hook and Line.—The following interesting letter from Mr. W. F. Lehman of Winthrop, Mass., is typical of many received at the Aquarium relative to unusual experiences of anglers:

"While fishing in Buzzards Bay, off West Falmouth, last July, my son caught a shark-sucker on a hook and line while fishing for scup. The fish was hooked in about three fathoms of water. The shark-sucker bit a hook baited with squid. In thirty-five years fishing in Buzzards Bay this is the first instance that has come to my notice of catching this species with hook and line. After the fish was dead his 'sucker' still functioned and for some hours it remained clinging to one of the piazza posts of the house."

Answer.—The shark-sucker derives no direct nourishment from the shark which he accompanies on its wanderings. He is one of Nature's deadheads or stow-aways—a seeker of free transportation and protection, living on the scraps to be picked up when the shark is feeding.

The shark-suckers living in the Aquarium sometimes leave the shark to which they usually cling and roam about the big tank in search of bits of food they may have missed at feeding time. It is not unlikely that the fish you hooked in Buzzards Bay had merely deserted his shark companion long enough to seize your bait, which was small enough to be overlooked by a shark which you did not see. Sharks occur in Buzzards Bay just as they do in most other bays along the coast and are nearly always accompanied by suckers. Your observation that the "sucker" of this fish continued to function after death is interesting. We will experiment with the first dead shark-sucker available.

The clinging power of the sucking disc is highly developed. I have lifted one of these fishes attached to the inside of a bucket of water, raising fish, bucket and about twenty pounds of water from the ground.

A Long-lived Sea Lion.—The Aquarium has recently lost one of its eldest and most interesting inmates, a California Sea Lion (*Zalophus californianus*), that lived in the building nineteen years. This animal, supposed to be about four years old when purchased in 1907, was probably not less than twenty-three years old when it died. It weighed 620 pounds in 1916 and later became somewhat heavier, developing the knob on the head that is characteristic of adult males of this species.

The age of this sea lion is apparently the best longevity record of the species. Very little is known of the ages attained by wild animals. The length of life in captivity, where an individual has long been kept under observation, still furnishes the most trustworthy clue to its age.

A Jonah Fish.—Among the fishes collected in Florida by employees of the Aquarium during the month of June was a black grouper weighing over two hundred pounds. Its great size an enormously large mouth make it one of the prize exhibits.

Soon after the arrival of the grouper, a young brown shark two feet in length, was placed in the same tank and was swallowed by the grouper at a single gulp. This totally unexpected performance filled the collector of the shark with amazement and regret, as another grouper of slightly smaller size has lived for years with smaller fishes on entirely peaceable terms. These are Nassau grouper, dog snapper, ocean trigger fish, margate, yellow-fin grouper, sheepshead, black drum and channel bass, all small enough to be swallowed except the last.

As the Aquarium usually keeps about 200 kinds of fishes in its 100 tanks, it is necessary to make some combinations. The "compatibilities" are of course consulted so far as known. When not known the experimental method is tried and not always with success, the principal food of fishes being other fishes. The behavior

The wreckfish (*Polyprion americanus*). From a photograph by Marie Poland Fish.

of a single fish does not mean that another of the same species will act similarly under similar conditions. Later on the big swallower was fed on dead dog sharks, each considerably more than two feet in length, for all of which he promptly found room inside.

*Reptiles and Amphibians.**—In this well-printed book of a little more than a hundred pages, Dr. Barbour has provided a scientifically accurate and very readable account of a class of animals to which he has devoted much study.

There are 142 very satisfactory half-tone illustrations, many of which are new. A dozen or more of these are credited to the New York Zoological Society. We happen to be well acquainted with the large Swan Island Iguana admirably portrayed in the frontispiece and have seen it many times in its native island, as well as the remarkable marine iguanas and giant tortoises of the Galapagos also well illustrated.

The habits and adaptations of many kinds of reptiles and amphibians are set forth both instructively and interestingly. There is much new matter on reptilian behavior. This work does not attempt to cover the field of herpetology in detail. The field is too large, there being more than 6,700 species of reptiles and amphibians now known. It is a general consideration of the subject, based in part on the author's lectures in the Lowell Institute. To the general reader the value of a work on natural history is often gauged by the answers it provides to his questions. Although familiar with living reptiles in many countries, and accustomed to use the standard works on herpetology, we have applied the above test to this book with a large measure of satisfaction. The New York Aquarium is frequently called upon by teachers to recommend convenient books on natural history subjects. This book of Dr. Barbour's will be added to our list.

* *Reptiles and Amphibians.* Their habits and adaptations. By Thomas Barbour, Curator of Reptiles and Amphibians in the Museum of Comparative Zoology at Harvard College, Boston. Houghton, Mifflin & Co.

By M. P. Fish

A European Visitor to American Waters.—When the fishtraps were hauled off No Man's Land—a small island seventeen miles south of Cape Cod and about two hundred miles eastward along the coast from New York, one day in August, 1925, a strange specimen unknown to local fishermen was captured and brought in alive to the U. S. Fisheries Laboratory at Woods Hole, Mass. Examination showed it to be the young of the wreckfish (*Polyprion americanus*), a species found in Madeira and the Southern Indian Ocean, occurring frequently along the European coast from Norway to the Mediterranean and the Cape of Good Hope in water at least 300 fathoms deep, but only twice before recorded on this side of the Atlantic. A Gloucester fishing vessel some years ago took one small specimen in the deep waters of the Gulf Stream in the Grand Banks region, recorded by the U. S. Fish Commission. A second was taken by hook and line on August 21, 1910, eight miles off Asbury Park, N. J., by Capt. Harry Maddox of the Yacht *Carib*, according to the Zoological Society Bulletin for November of that year. It was about 10 inches in length, weighing 13 ounces, and was colored bright yellow mottled with black.

The present specimen, when captured, measured not more than 6 inches and was blotched with irregular patches of grayish white and black. The large scaled head with numerous spiny crests and furrows, and the much protruding lower jaw with its fleshy bumper at the tip were the most outstanding charactertistics.

The fish lived well in captivity, spending the winter in the Boston Aquarium, and being returned this summer to Woods Hole. Through an accident to the aquarium it was killed on

July 28. Development had taken place with extreme rapidity, so that in less than a year it measured 16½ inches from tip of lower jaw to tip of tail, a gain of approximately 10 inches, and had assumed the plainer coloration of the adult—steel gray in life with bluish and silvery reflections, darkest dorsally and becoming light silver beneath, the vertical fins dark gray, the ventrals narrowly edged in white, and with white patches above and below at the tip of the caudal fin.

Very little is known concerning the life history of the wreckfish. The young are often seen inshore in European waters especially about rocks, and the name is appropriately given through their custom of living beneath floating logs and wreckage. It has been suggested that by this means the few stragglers taken on our coast have found their way across the ocean.

By Ida M. Mellen

Physiology of Amphibians.—An epidemic of zoology text books has been raging of late, but the market is not glutted with special laboratory manuals on the amphibians. Holmes[1] and Smith[2] provided us with good manuals on the frog, and there is just off the press a manual by Adams[3] on the mud puppy, quite another type of amphibian and one of the most valuable of the lower animals for classroom work in physiology and anatomy.

The mud puppy (*Necturus maculatus*) usually on exhibition at the New York Aquarium is a reddish-gray animal about a foot in length, remarkable for its beautiful dark-red external gills. Unlike frogs and toads, and many salamanders, it never develops lungs, maturing, breeding and dying in the gilled state. In this respect it resembles the hellbender and the giant Japanese salamander. All three are edible species.

Mr. Francis O. Schmitt of Washington University, St. Louis, last summer demonstrated kidney function in large salamanders before the Twelfth International Physiological Congress at Stockholm. Both the mud puppy and the hellbender, he said, afford wonderful material for studies of this kind. At the eleventh hour before sailing, his expected source of supply failed and he was provided by the New York Aquarium with the animals necessary for his demonstration.

Quoting from a letter of Mr. Schmitt to Miss Mellen:

"In Necturus the kidney is most easily accessible for experimental work of any animal we have tried. Owing to the enormous size of the glomerulo-tubule systems on the ventral surface of the pelvic or urinary kidney, we have been able to enter these elements with a micro-pipette and analyze chemically the fluids withdrawn from various levels. This settles by direct evidence problems in renal physiology which could hitherto be attacked only by indirect means."

The new manual by Adams is a little book of sixty-seven pages and covers the skeletal, muscular, circulatory, glandular, digestive, reproductive and nervous systems of the mud puppy. As a classroom manual, its value is self-evident.

[1] Samuel J. Holmes: The Biology of the Frog. 1906. The Macmillan Co.

[2] Bertram G. Smith: Laboratory Guide for the Study of the Frog. 1917. Press of the New Era Printing Co., Lancaster, Pa.

[3] L. A. Adams: Necturus, a Laboratory Manual. 1926. The Macmillan Co.

Spawning Habits of the Bullhead Catfish.—Mr. H. S. Ward of Philadelphia, while at Bridgton, Maine, last summer, made a most interesting observation upon the breeding habits of the common catfish or bullhead—called also horned pout in New England. In a letter to Miss Mellen, he says: "The adults formed two guards, an outer and an inner, the outer guard scouting around, while the inner herded the fry in a lazy circle. At regular intervals the two adult fishes met for a moment, exactly as though they were reporting to each other. The inner guard would also cross and criss-cross through the herd, evidently to see that no danger lurked in the murky center. A native told me that year after year this particular cove is host to one, and only one, bullhead family. It is pleasant to think that it is the same pair, faithful to their native heath, but I am inclined to doubt it."

Mr. Ward is right in assuming that it is probably not the same pair that occupies the cove each year, for fishes do not mate permanently as many birds do. Probably the first pair to arrive at the cove in the spawning season remains in possession throughout the breeding period, according to fish etiquette.

Age Attained by Goldfishes.—Many times during the course of a year the question arises, How long does a goldfish live? Several goldfish farms in this country attest the fact that specimens have lived upwards of a quarter of a century, and at the Bruce Goldfish Fisheries in

Thornburg, Iowa, specimens twenty-five years old reached a length of twenty-four inches. Hugh M. Smith's now classic article on the goldfish, published in the National Geographic Magazine for October, 1924, was accompanied by a picture of "The most venerable goldfish in Japan," which was, however, only nineteen years old.

A young lady in New York state, writing the Aquarium for advice on the preservation of a goldfish that had just died, stated that the specimen had been in the family for about twenty-five years. It was only four inches long, but it is a matter of common observation that aquatic animals confined in small quarters do not attain their full growth. A goldfish maintained in a home aquarium for a quarter of a century may thus record a maximum growth of four inches, while a goldfish allowed the freedom of a pond, even if only in the summer season, will add to this another twenty inches.

Goldfish for Rags.—According to the winter number of The Amateur Aquarist (London) a ragman in London streets has been offering a goldfish in a globe in exchange for rags. His cry "Goldfish for rags!" has brought many eager people to his cart, willing to make the exchange of cast-off clothing for a live fish.

Mr. Hodge, editor of The Amateur Aquarist, followed up the fate of twenty of these goldfishes and found that at the end of three days only one was alive. He sent a letter to the head master of the local school, containing useful hints on the care of the aquarium and asking that these be read to the scholars, in the hope that the lives of some of the fishes might yet be saved. The letter was not acknowledged nor read before the scholars. Mr. Hodge states that "though tens if not hundreds of thousands of goldfishes are imported annually (into England) there is never a glut of them either on the market or in the home."

Conditions across the water in this respect seem to differ little from those existing in this country, excepting that our teachers are most eager for natural history information and it would be difficult to find one who would refuse to read to the children such a letter as Mr. Hodge prepared on the care of the aquarium.

A druggist in Brooklyn must have heard of the London ragman, for he has been offering a goldfish in a globe with each purchase of a certain brand of tooth-paste!

By C. M. Breder, Jr.

A Volume of Lower California Zoology.—The American Museum of Natural History has collected in a handsomely bound volume entitled *The U. S. S. Albatross in Lower California Seas,* fifteen pamphlets relative to the zoological work of that vessel in the year 1911.

The introduction, the narrative of the voyage, two reports on mammals, one on birds and part of one on deep-sea fishes are by Dr. Charles Haskins Townsend, director of the expedition. Mr. J. T. Nichols collaborated in the report on deep-sea fishes.

Other reports in the volume on the large collections made during the voyage are: Insects, by John A. Grossbeck; Echinoderms, by Hubert Lyman Clark; Shore Fishes, by Raymond C. Osburn and John Treadwell Nichols; Lizards, by M. C. Dickerson; Amphibians and Reptiles, by Karl Patterson Schmidt; Annelids, by Aaron L. Treadwell; Copepods, by Charles Branch Wilson; Brachyuran Crabs, by Mary J. Rathbun and Amphipods, by Clarence R. Shoemaker. Another volume devoted entirely to the Mollusca, is in preparation by Paul Bartsch.

The reports as a whole constitute an important contribution to the zoology of the region explored. They fill more than 400 printed pages and are illustrated with 160 half-tone plates and cuts in the text. Nearly all of them contain descriptions of new species. Much of the narrative is devoted to oceanographic investigations and to the fishery resources of the Gulf of California.

The book is dedicated to Mr. Arthur Curtiss James, a trustee of the Museum, through whose munificence the institution was enabled to cooperate with the U. S. Bureau of Fisheries in the expedition of the *Albatross* to the Gulf of California and to share in the collections that were brought back.

The bound edition of these papers, limited to one hundred copies, has already been distributed to natural history museums and biological laboratories at home and abroad. It is among the last of the hundreds of reports that have been published on the work of the *Albatross,* the vessel having been sold after nearly forty years of oceanographic and fishery service.

Sunfish Nests.—The accompanying photographs were taken from the shore of one of the Essex County (N. J.) Park lakes this spring without any special equipment. The views obtained were made possible simply by selecting

Common sunfish (*Eupomotis gibbosus*) guarding its nest.

Red-breasted sunfish (*Lepomis auratus*) guarding its nest.

the proper angle of view in relation to that of the sunlight.

The eggs may be seen as a whitish mass immediately in back of the fish, which is engaged in fanning its fins to prevent the settling of silt and insure a circulation of fresh water. Note the clean pond bottom. This was produced by the activity of the fish as the adjacent bottom was uniformly covered with a layer of fine mud. The large dark patches are floating masses of algae.

This smaller and more common species makes a less regularly outlined nest. The eggs are smaller than those of the preceding, more nearly transparent and generally so hidden by the pebbles as to be completely obscured from shore. The unaltered pond bottom can be seen in this view, especially in the left background.

Marine Growths on Seahorse.—This season the marine growths, such as ascidians, barnacles, and bryozoans were unusually heavy and necessitated beaching the collecting boat *Seahorse* to clean out the holes leading into the live-well so as to ensure sufficient circulation for the captured specimens. A special sheathing inside the well was tried this year for convenience in removing the fish, but it so encouraged obnoxious growths that we were forced to remove it.

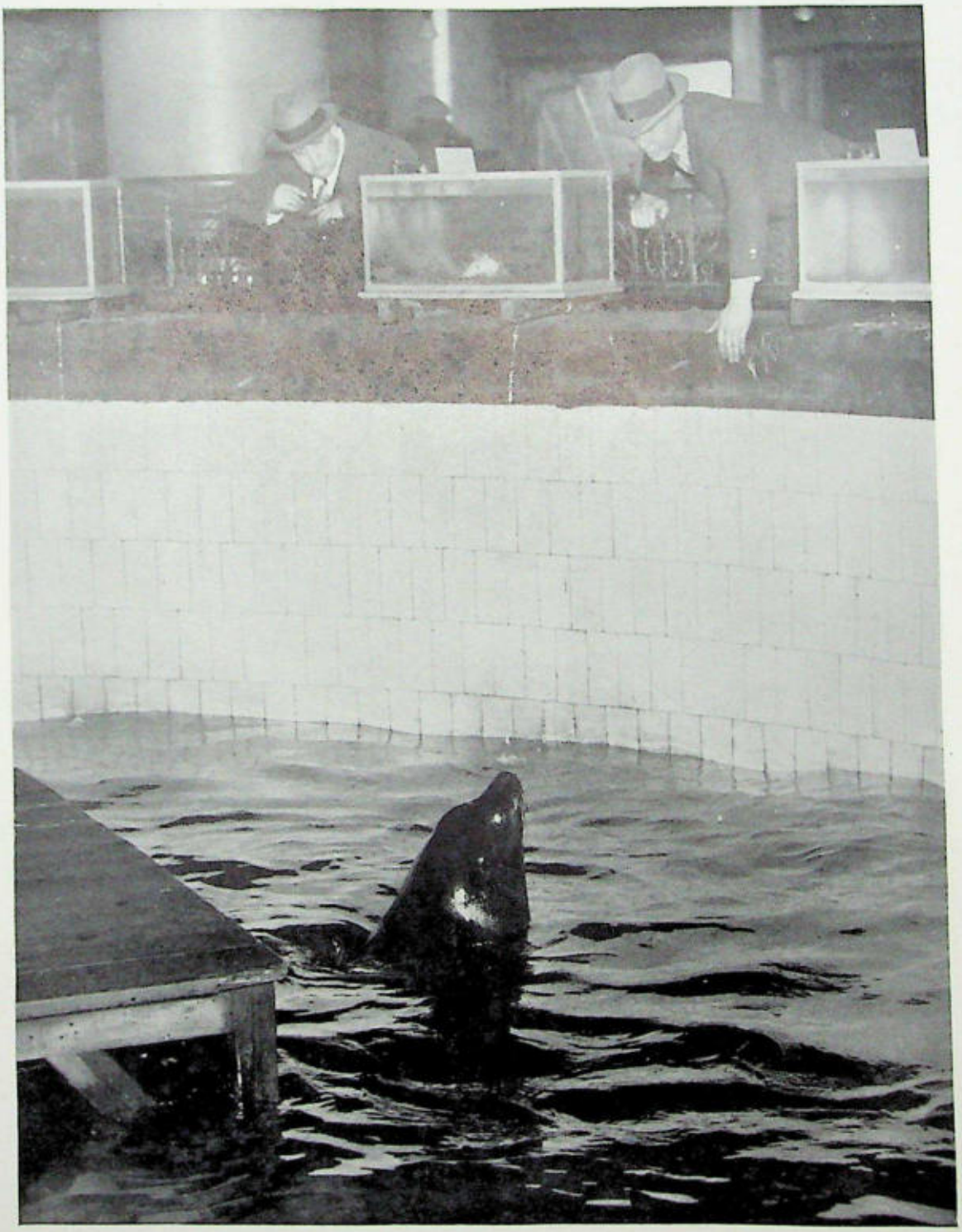
Seahorse Notes.—With the passage of this season the Aquarium collecting boat *Seahorse* ends its seventh summer of local collecting. As usual, most of the work was done in Sandy Hook Bay in order to profit by the great assortment of species to be found there in the commercial pound nets.

Since the early days of the *Seahorse*, fishing has steadily fallen off in this bay. In fact the first two years of her activity forty-pound nets were variously scattered about the area. One after another of these trap-net fishermen have been forced out of business so that today only a bare dozen remains. Opinions are various as to the causes of such absences of fish life. Anglers are wont to ascribe disappearances to over-fishing by the commercial fishermen, commercial fishermen are apt to talk at length on the deleterious effects of pollution and biologists are given to discussing climatic and food conditions of that great reservoir, the open sea. Probably the fundamental causes, in any event, are not nearly as simple as many would have us believe.

Be that as it may, the work of collecting by the *Seahorse* has not suffered on account of this falling off of food fishes at Sandy Hook for the non-commercial species, although apparently remaining in about the same proportion as to individuals, if any thing, have increased in the number of varieties. Each year we take a few specimens of fishes not typical of the local fauna. That is there are always a few accidental wanderers from adjacent regions which do not appear regularly. Amongst those of this nature taken this year we have a sea trout (*Cynoscion nebulosus*), the southern representative of our weakfish, generally not found north of Delaware. In September we took three lizard fish (*Synodus foetens*) only occasionally recorded from local waters and a young butterfly fish (*Chaetodon ocellatus*). Probably the most interesting specimen taken this year was a common flounder (*Pseudopleuronectes americanus*) about six inches long which was not only white on its under surface

Marine growths on the hull of the collecting boat *Seahorse*. The boat was beached and careened to facilitate scraping her bottom. The lower pictures are close-ups of marine animals on the hull and special sheathing.

but on its top side as well. The only pigmentation that it had was a ring about the orbits and a tinge of color in the fins. It is not particularly uncommon to find flounders with patches of color on the under side, which is normally white, but as this side is usually hidden it can have but slight importance to the individual's happiness and success. However, when these fish lack color above it is another matter because the coloration of flounders is supposed to have great protective value and it is a matter of observation that they change their color and pattern to match closely the bottom on which they happen to be lying. An extreme proponent of the significance of protective coloration should be able to give an interesting explanation as to how this prominent white mark on the sea bottom managed to elude its enemies for the two or more years of its life before it was drawn up in our seine along with a few of its fellows to spend the rest of its days in the protected environment of a glass-sided tank.



California sea lion in the New York Aquarium. He lived nineteen years in the Aquarium. From a flashlight photograph by Morris Rosenfeld.

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Leopard

ZOOLOGICAL SOCIETY BULLETIN

Published *by the* New York Zoological Society

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A Malay houseboat is the most ramshackle looking, and the most comfortable craft in the world.

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VOLUME XXX JANUARY-FEBRUARY, 1927 NUMBER 1

MALAY DAYS

By WILLIAM BEEBE

I SQUATTED cooliewise on a fallen tree-trunk, poised gingerly on my toes, for the leaves about me were all aquiver with hungry leeches. Behind me was the rose-covered dak bungalow on the crest of the Malay mountain range. In the compound the mail-lorry smoked and snorted and resented every attention which the Chinaboy mechanic paid to the reluctant engine. Before me, and far beyond intervening valleys, stretched the bamboos and tree-ferns of the Pahang hinterland, whither I was bound.

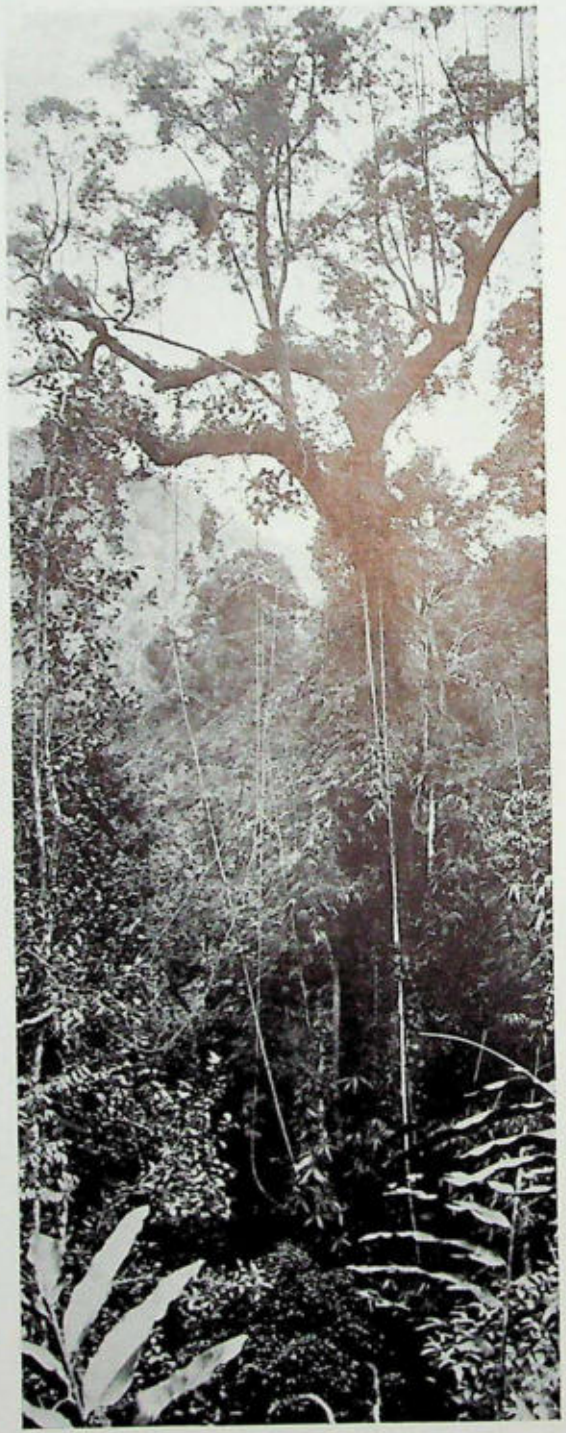
At this very moment, across the ranges, far to the eastward of my fallen tree, a sultan and his court and nobility, armed with kris and knife, and clad in silks and satins of rose and blue and emerald, were making their way slowly to the central square of their town, eager to begin the day of top spinning. Nearer to my dak, close under the lofty jungled heights, deep within a blind, hanging valley, six white men weltered in the stifling heat and planned the impossible—the combatting of virulent cholera among superstitious Malays. And still nearer were wild men of the mountains, Sakais, almost monkey-like in their life, and wandering lepers with dissolving surfaces which once were faces.

And in the same country with all these people whose lives were respectively so incongruous, so hopelessly altruistic, and so pitifully hopeless, threading the bamboos and the tree-ferns were wonderful pheasants, indescribable argus, and green peacocks in flocks. These I sought, and of these alone I thought as the hectic horn of the mail-motor gave forth a cracked, blatant blast. I rose, flicked off a few threadlike leeches hastening over my puttees, and made my way back to the dak compound, the little level acre balanced on the shoulders of the mountain pass, filled with roses and the odor of burning oil and ill-mixed gasoline. Kuala Lipis is very near to one's visualization of Hades, so it was appropriate that the mail-lorry should always arrive in weltering heat, with blistered rubber tires and boiling engine.

Far behind, as we left the higher altitudes, the last tree-ferns and bamboos disappeared, and here we found dense jungle tangles, warped and woofed with thorny rotans and climbing canes, while every open spot was self-sown with coarse elephant grass.

From the small shadow of the dak veranda I looked through the glaring heat across to a few scattered hospital buildings. A dozen yards down the white dusty road was the single store, and behind was the inevitable clubhouse. Beyond these, in all directions, rose the irregular heights of mountains, admitting two small rivers but no air or coolness. The heat and humidity seemed to gather in trembling waves over the steep jungle-slopes, and all day to roll downward, making of Kuala Lipis a furnace, a nerve-destroying place of dust and silence. Two dozen Malays, a scattering of Chinese, and six white people existed in this valley cauldron.

At daybreak a chorus of dyal birds awakened me, and the distant crow of a wild jungle-cock brought me to my feet with a leap. Then came a dismal clank of iron links, and a half-dozen convicts, all lugging balls and chains, filed up, under an armed Sikh guard, and proceeded to do chambermaid, janitor, and gardener duty. It was an experience worthy of this weird



The blue peafowl of India is a bird of the open country but the green Malayan species inhabits the jungle. When alarmed, it flies into the tops of the tallest trees to watch for danger. Tigers and and leopards are their worst enemies.

Malay land to have one's room swept by a leering, villainous-mouthed Chinese murderer, with his ball rolling about the floor after him, and getting tangled in bed-legs and chair-legs. Finally, laden with garbage and weeds, the anvil chorus died away in the distance. Later, we saw two members of the gang painfully rolling the tennis-court, carrying their iron balls over their shoulders so as not to damage the court.

I made a short, unsuccessful trip to the jungle, and returned well torn by thorns and with no hint of pheasants heard or seen. Then I called on the three white men, made arrangements to go down river on the government houseboat, and was invited to a formal dinner the coming evening. In breathless heat we donned full evening dress, and soon there arrived the half-broken rickshaw which was the only vehicle Kuala Lipis possessed. By dint of one man pulling and another pushing, we accomplished a hundred yards or so, and then had to walk the rest of the way through dense reeds to the house of the Government Agent. The air was still and saturated. Crickets chirped, an elephant trumpeted far in the distance, and once the pulling convict shied, and we stood still while a big black cobra undulated slowly away into the reeds.

We dined on a full-course English dinner, waited on by a quartette of turbaned Indians, with the perspiration pouring down their shining faces. The lamps were gratefully dim, the servants stood silent as ghosts. The atmosphere was tense with an undercurrent of racked nerves.

All knew that a deadly epidemic of cholera was surely working its way up river, and preparation for this added to the ghastly climatic and isolated conditions of their daily life.

The club was a cheery little building, which gave an impression of coolness that its thermometer refused to second. There were old magazines, an interesting little library, a tennis-court a bit weedy and aslant, and a fifty-yard golf-course, besides an abundance of whiskey and soda-pop.

The third day fever descended quickly upon me, and as the white physicians had gone down river in an attempt to head off the cholera, I sent for the Bengali doctor left in charge of the hospital. He took several hours to dress up in honor of attending a white Sahib, and appeared with hair shining with grease and a collar and necktie, whereas Kuala Lipis etiquette demanded only an undervest. With him he brought a large, black, locked bag, as shin-

ing as his hair. From this he took a pair of goggles, and began a series of questions more appropriate to the victim of a census-taker than to a fever-stricken Sahib. I lost patience at this juncture, and demanded a certain definite specific which my kit lacked. Rather crestfallen, from the very bottom of the bag he fished out the powders I wished, and when he went to mix them, my sense of humor and curiosity overcame my excess of temperature, and I opened the bag and found that it was empty. My specific had exhausted the dusky physician's resources. It was true Bengali philosophy—an inverted Christian Science!

After another day, the Kuala Lipis cauldron began actually to steam; for the monsoon set in and rain came down in torrents all night and was drawn up again through the heated air all day. My fever vanished, and in spite of dismal warnings I got my possessions aboard the tiny houseboat and stretched out full length in my water-line berth, waiting for the retinue of servants-of-all-nations who were at the village bar, absorbing cholera medicine. As I rested, dabbling my hand in the tepid, muddy stream, the houseboat swung out a little, leaving a ribbon of open water between me and the shore.

Cleopatra was addicted to houseboating of sorts, and she was supreme in beauty, tact, and courage; houseboating gave freest play to Mark Twain's humor; Moses knew the delights of quiet drifting through reeds and rushes, and great wisdom was his portion. Whenever I go a-houseboating,—and I go whenever I can,—I also attain supremacy—in contentment. Volplaning earthwards from eight-thousand-foot levels, running before a steady breeze in a catamaran—these are smooth, efficient, but tense methods of progress. But to lie in canoe or houseboat and let the current of some stream drift you where it will is a mastery of relaxation. You become a veritable corpuscle in an artery of Mother Earth, one with the drifting leaves all about, and a worthy member of the little company which acquires merit at the shrine of kindly Jabim.

When tearing across the face of the earth in a train, or surging ahead in a great steamer, I usually have a boding feeling of finality: this little farmhouse or that crow-dotted clump of trees I shall surely never see again; the distant island must be dropping irrevocably below the horizon. Drifting, however, engenders a peculiarly optimistic frame of mind; I am complacently confident of coming cycles; I am conscious of a close spiral of reincarnation. Like the drops of water which support and drift with

The gibbons are considered the lowest of the anthropoid apes, although they are the only members of the group that habitually walk upright. Their loud calls are typical of Malayan jungles, where they are known as "wah-was."
Photograph by Elwin R. Sanborn

In the houseboat one may paddle and push one's way into the wildest side notches of the river, where monkeys and hornbills come close, and peacocks and wild cattle watch in the early morning mist.

me, I pass mighty tacubas and fallen trees, masses of brilliant bloom and peering monkeys, with a satisfied conviction that, like the drops of water, I shall again return to drift down this stream, and again rejoice in all its beauty and mystery.

So, when my motley crew was gathered, I gave Matsam, the Malay captain, orders to drift, not paddle. But even when the six inches of open water between boat and shore had increased to as many yards, I found that I was still within the British sphere of kindly influence, and the District Officer ran down and tossed across to me a big green hand-grenade-looking thing, shouting that he had just picked it from his garden—the biggest cucumber ever grown in Malaysia.

If there was a Lloyd's rating of houseboats, my craft would occupy an intermediate position. It was far superior to an ark of bulrushes, daubed with slime and pitch; but, on the other hand, it was not of beaten gold, or provided either with silver oars, or purple, perfumed sails. But the Strander, as I called it, from its chief occupation, had a jolly little cabin amidships, with storeroom and kitchen aft, and men's deck and paddling-space forward. Overhead was a tiny awninged nook just large enough for a steamer-chair; while over the storeroom sat the captain, with a tiller-end which wandered aimlessly but effectively down and back to a rudder far below.

My cabin was a magic cabin; and just as magicians of old wrought their spells by necromantic passes, so I controlled the metamorphosis of my cabin by posture. When I lay in my bunk it was bedroom, when I sat up, my head boy Aladdin wafted in a tiny table from somewhere, and it became dining-room. With the curtains lowered, I stood and leaned over my various trays and graduates, and my cabin became dark-room. And finally, when my rookha chair was brought and an erring member of the crew summoned, the dignity of a court-room descended upon the lowly little place.

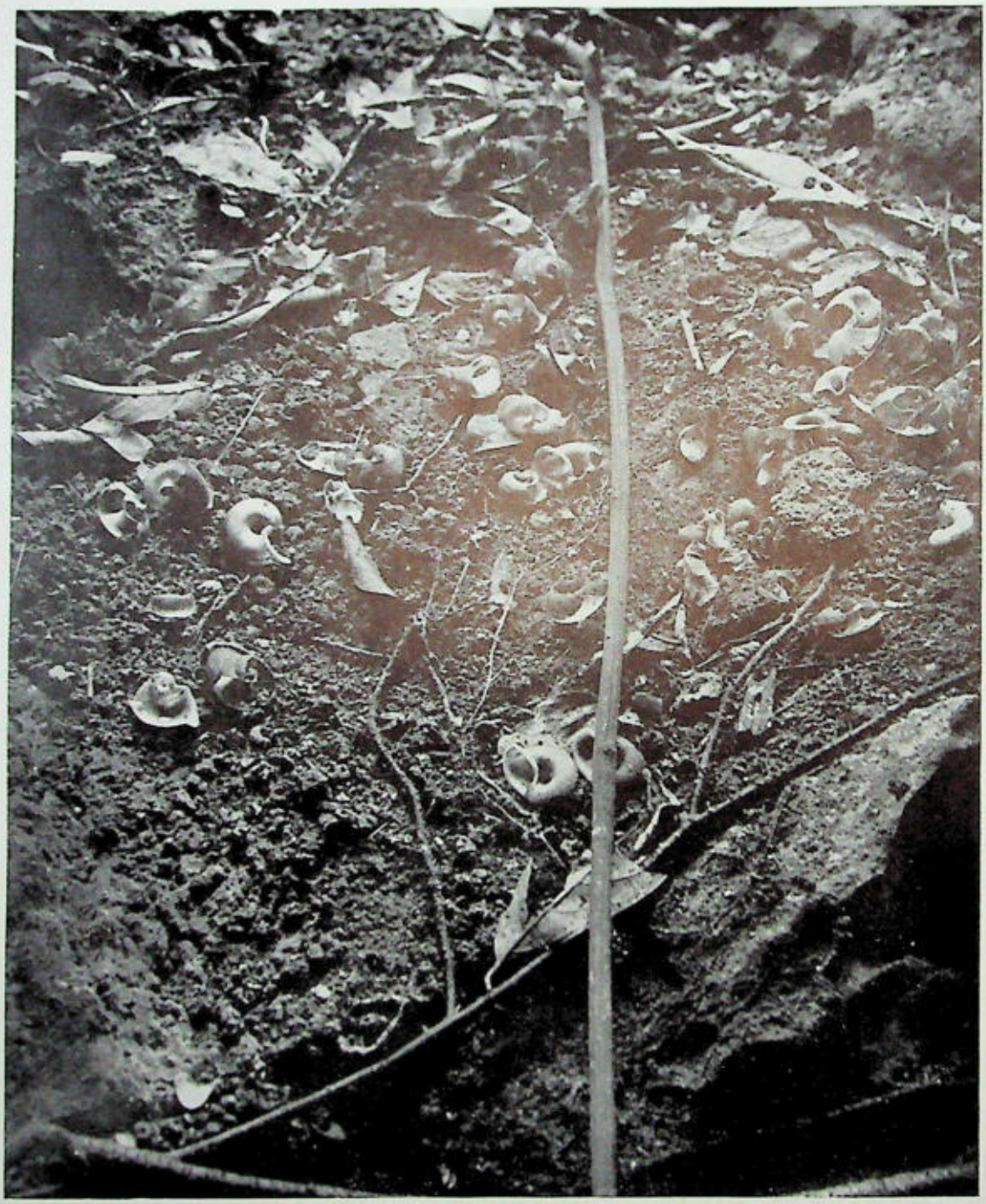
So began days of drifting, and never in my experience was a crew more enthusiastic about a mode of travel. Only for occasional meals and more frequent strandings did they break their slumber. One of them I doomed to stand continual watch because he snored unpleasantly. I could not find the Malay word for snore, so to this day he never knows why I picked on him. An extra allowance of pay, however, palliated my linguistic ignorance. Even if I could have made my motive clear, I should have been in difficulty; for another paddler also snored, but in a minor, inoffensive key, his timbre and rhythm partaking of the quality of natural sounds around us. In fact, for several days I mistook his ronflement for the sound of a gentle wind, or water rippling beneath the bow.

Day after day I drifted down the Jelai, sometimes stranding on a sandbar, which would be so interesting that I spent the day. At evening we would tie up to an overhanging branch beyond the reach of mosquitos and leeches, and swing slowly at the best of wind and current. In the heart of one of the wildest regions of the world, with elephants and tigers, fierce black leopards, and equally dangerous wild cattle in the surrounding forest, it was a joy to lie in pyjamas full length in my bunk in the cool air, dabbling my hand in the water, and listening to the night sounds of the Malay jungle. My dabbling was intermittent and rather conscious, and always on the shore side of the boat, for crocodiles were too abundant in mid-stream to permit of carelessness, although I had just taken a plunge and a good swim.

I clapped twice, and my Singhalese boy Aladdin appeared with a lime-squash; and as I sipped it, I thought of envious friends at home. But I wondered how many of them would have enjoyed earning this luxurious hour by the day's tramp through swamps, crawling through leech-infested thorn thickets, with heat and gnats and crackling leaves hindering the noiseless approach to a flock of peafowl, or a solitary argus, or a family of peacock pheasants. Only aching muscles and excited memory of new facts achieved could make perfect the enjoyment of such an evening.

From the front of the boat came the sound of low, minor singing, my Malay paddlers droning weird falsetto songs or sleepily chanting proverbs in turn. A great fish, perhaps crocodile-chased, leaped frantically into the air, so close that a shower of drops fell on me. From a long distance away came two sounds, low and of short duration, but powerful in their appeal to the imagination: the brazen trumpet of an elephant and the penetrating cry of a male argus pheasant on its dancing ground. Then arose a muffled, palpitating series of vocal waves, which rolled in, rising higher, clearing to a crisp utterance, and finally reaching the full swell and power of a rollicking chorus of wah-was or gibbons—great ape-like monkeys which fill the Malay jungles with the exuberance of their emotions.

An unfinished dancing place of the Occllated Argus Pheasant.



Remains of snail feasts of Peacock Pheasants.

Jungle flowers are eaten by pheasants. They grow among bizarre orchids and lofty tree-ferns, but are as simple in appearance as any flowers of our northern groves.

No imaginable sound would seem less fitted to the wilderness—it was so unsophisticated, so youthful, so full of joy and laughter. It recalled the words of Dunsany's frightened Man: "Rock should not walk. . . . Rock should not walk in the evening." And here in my swaying houseboat I listened and said over and over again, "Children should not laugh in the jungle.—They should not laugh in the jungle at night."

At last the wah-was died down to a low, sleepy mumbling, with now and then an individual, ringing, staccato whoop, like the final dying flares of the fire-music. Soothed and rested, I turned over and had almost found slumber, when I heard a suspicious swashing forward. I sat up, reached for the electric light which lay with my revolver, and leaning far out over the water, suddenly flashed it along the boat. There was the villainous Chinaboy cook in sharp silhouette, washing a handful of forks, knives, and spoons in the river. I leaned back and clapped for Aladdin.

"Bring cookie, lantern, pail of boiling water, dishes."

"Going, marster."

Cookie appeared and salaamed, rather yellow-white and trembling. Aladdin's eyes were big with excitement.

"I told him always cook spoons." (Aladdin always allied himself with the side of right early in any dramatic situation.)

"On your knees, cookie, and wash each fork carefully in boiling water." (This he had been told to do at the beginning of the trip.)

"If ever not do so again, will throw overboard to crocodiles."

Cookie, whiter, mumbles to Aladdin, who whispers officiously aside, "Tink will never do again, marster" (as one Supreme Court Justice confers with another).

Each night afterward, however, there occurred the rite of "visible spoon-washing." Often I would not be there, but would come in from the jungle to find cookie on his knees washing to an empty cabin; and once, coming softly, I surprised Aladdin, sitting in my rookha chair, receiving the obeisance of the ritual in solemn state. He was extolling "Marster's" lenience in not throwing cookie to the crocodiles; so I pretended not to see him, and, coughing, gave him a chance to seem making ready the bed for the night, although the clothes were already turned down.

With dead cholera victims floating past, children and others, and two hundred cases dying down river out of every two hundred, I dared take no risk. Our drink was the universal Japanese mineral water Tan-san, or thrice-boiled river water.

A moment's pause in the steaming jungle, and every leaf seems to be a-quiver, as the swarming leeches gather for the prospective feast.

Another evening and its following day—the day of peacocks—stand out even among a month of wonderful Malay days. We tied up in some unknown reach of the Pahang on a moonless evening, when men came softly and, talking to my boatmen, wished to be hired. I needed some extra help, so called ashore to engage three. Before I slept I looked out and tried to pierce the blackness; but the jungle rose, a solid wall of jet, sending to my strained senses only an occasional fragrant wave of perfume from nocturnal blossoms, a shrill monotone of insect, or the sinister sighing of some small animal. Once a half-submerged tree drifted past, scraping the sides with its withered foliage, and flicking

Upper: Plume flowers growing close to the water and filling the midnight air of Malaya with perfume. Lower: Giant bignonias of the Malay Mountains.

Giant tree-ferns lift their heads of emerald lace above the bamboos and thorny rotans.

Plants which climb and creep on the bark of trees like vegetable serpents, clinging with leaves as well as with stems.

off a beautiful tree-cricket, which awakened me by crawling over my face. After its capture the night passed quietly.

To wake in a tent, open the flaps, and look out is good; to sit up in one's blanket cocoon in a hammock and see the jungle dawn is better; but best of all is opening one's eyes in a house-boat bunk, and without further movement seeing water and jungle and sky, and the exciting early morning doings of fish, crocodiles, birds, and monkeys. One feels as yet unburdened with a human frame; and for an hour I am only a pair of disembodied eyes, which search and record, begrudging even the interruption of winks, and viewing all through fresh-colored sidewise vision.

As one wakes slowly from slumber, so came the dawn, gradually, in these tropical lowlands. The glare of the sudden leap of the sun above the horizon was dimmed, delayed, diluted, by the thick morning mist—mist whose grayness I loved to think of as the exact shade of "elephant's breath." As I looked out over the side of the boat, the swift current became more and more distinct through the fog, which drifted slowly downward like a sluggish, aerial river flowing gently over the denser one below. As the light grew and the mist lifted and frayed upward, a brown line quartered the fore-glow in the sky and masses of foliage took shape and color beyond the sand-banks. Here and there white-barked trunks gleamed like ghosts; the saturated air was heavy with the odor of plume-blossoms, and the eddies were filled with their petals. A pair of great hornbills crossed high overhead, hidden by cloud-mist, but registering every wing-beat in a loud, deep, whoof! whoof! Bulbuls burst into song, drongos sent down their hoarse cries from the tree-tops, with showers of drops which pattered on my cabin roof.

Another veil of mist was drawn aside, and I sat up, breathless and tense, for on a sand-bar up-river and up-wind four great black forms became dimly visible—giant, statuesque sladang, the biggest bull standing at least six feet at the shoulder. Even against the pale sand their cream-colored stockings showed clearly, and their magnificent curved horns lay far back as they stood with nostrils outstretched toward me, striving to make out by sight what the wind refused to explain. We seemed harmless—some huge tree stranded during the night; but with wilderness folk, vague suspicion is interpreted as proved danger, and the wonderful jungle cattle, still headed our way, moved slowly through the shallows around and behind an arm of foliage.

The other end of the sand-bar held for me even greater interest. Resting my stereo glasses on the edge of the bunk, I was fairly in the midst of five green peafowl. They had me under surveillance, but were too confident of their powers to think of leaving. Two had sweeping trains which cleared the damp sand as they walked. Now and then a bird stood quite erect and flapped his wings vigorously, to rid the feathers of excess of moisture. I could even see the others shake their heads as the drops flew over them. Two young of the year were very active, running about, chasing one another, or stopping to scratch among the gravel.

A passing log drew the attention of the peafowl, and they all stood motionless, watching it, until they were certain it was wood, not crocodile. The sun shone brightly for a moment, and the mists swirled away, showing distant hills. Peal after peal of rollicking laughter came from a family of serious-faced wah-was. Then a rush of wind and fog blotted out the sun, and a sudden shower pitted the smooth water. From the depths of this renewed twilight rang the piercing, unrestrained cry of a wild peacock; and when I plunged in and swam swiftly to the bar, I found only tracks—cloven and tripartite—to hint of the rare vision which this fortunate dawn offered to me.

Returning, I clapped for breakfast and prepared for a long day's matching of my poor senses and wood-craft against those of the wary peafowl. I went ashore and was balancing my ammunition, when a face suddenly appeared, more horrible than any beast, more inhuman than the lowest monkey. It was but the memory of a face, and should have belonged to a corpse long since buried; but, instead, it surmounted a living, well-made body. Then I saw three men, and realized that I had engaged, "sight unseen," three lepers. I gave them money and food and sent them on their way swiftly, with Aladdin to escort them well beyond the limits of our explorations—a duty over which he was not enthusiastic.

This horrible shock, together with a brief but sharp return of fever, made that forenoon a nerve-fashioned mirage. I felt the change as soon as I was within the hot, steaming shade. The heat and humidity pressed upon me like material substance. I listened, yet dreaded to hear sounds, fearing them only less than the endless silence which framed them. When I squatted on a log, the rhythm of the hosts of advancing leeches would sometimes seem to merge into a thousand endless, undulating lines

The Ocellated Argus Pheasant, *Rheinardius nigrescens*. From a painting by G. E. Lodge, published in the fourth volume of "A Monograph of the Pheasants."

Tree Fern—Semangno Pass.

of vermin, closing in on all sides, and the feel of their measured loopings on neck or wrist or hat-rim was almost unendurable. The windless shush, shush of leaves under their combined movement increased, until it became a veritable bellowing. Once I stood up and fired both barrels of my gun into the tree-tops, and for a while my mind cleared. Then I watched a small python stalking a lizard—watched without interest, until I realized that I was observing a real tragedy and not a heat-induced mirage of the mind.

I longed to return, but knew I must not. I could not give in to this terror of jungle things which usually aroused only interest. Then came the climax. I had the chance of my life,—ten peacocks at close range,—and for a while was pulling myself together, when I fairly screamed and dropped my gun, leaping from my hiding-place and climbing ten feet into a tree tenanted by fire-ants, in a trembling sweat of fear. A tiny squirrel—one of the little dwarfs scarcely as long as one's hand—had jumped on my back, and I had reacted as from the charge of a buffalo.

The fever seemed simultaneously to have broken, and although weak and dizzy, I set out to achieve something definite before I gave in and returned to my bunk. The peacocks had taken refuge in distant, tall dead trees, high above the jungle; and clearing my neck and ankles of the abominable leeches, I began a stalk. I shifted my firing lever to the third, a rifle-barrel, and changed the .303 soft-nose to a steel-jacket. Only occasionally could I see my bird, a beauty in full plumage, who shared the bleached, lightning-struck giant with a trio of courting drongos. I dared not approach too close, and the last twenty yards I crept forward from the blind side, from which the bird's head was hidden by a splintered branch. When I first aimed, the gun-barrel wavered like wheat in the wind; but after sitting quietly for a few moments, I felt myself steadying, I thought of lime-squashes to come, and fired. The bird leaped a yard or two into the air, then spread wings and train and came down in a veritable tail-spin which awoke shuddering memories. Marking down the compass direction, I stepped heedlessly forward and went myself into a nose-dive of sorts. I fell and fell, and ended in a shower of sparks of physical pain. I had stepped off the edge of a sheer bank into a hidden gully, and hung suspended in mid-air in a cruel netting of rotan thorns. There was still eight feet more to solid ground, and for fifteen memorable minutes I was the plaything of gravitation and all the needle-thorns in the

(Continued on page 23)

New York Zoological Society

OBJECTS OF THE SOCIETY

¶ A PUBLIC ZOOLOGICAL PARK. ¶ A PUBLIC AQUARIUM. ¶ THE PRESERVATION OF OUR NATIVE ANIMALS. ¶ THE PROMOTION OF ZOOLOGY.

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MR. SANBORN INJURED

Mr. Elwin R. Sanborn, editor of the *Bulletin* and other of the Zoological Society's publications, recently suffered a severe nervous shock and a series of painful injuries to his face, hands and arms as the result of an explosion of chemicals and flash powder which occurred while he was at work in his laboratory adjoining the photographic dark room in the Service Building. Fortunately Mr. Sanborn was wearing glasses at the time of the accident, which afforded full protection to his eyes. But for this favorable circumstance he would undoubtedly have suffered some permanent injury to his sight.

For several weeks after the accident Mr. Sanborn was treated at Fordham Hospital but he has recently returned to his home. While still confined to his room, he is steadily improving and will doubtless soon be able to return to the Park. It is expected that no disfigurement will result from his injuries.—*W. R. B.*

HAITIAN EXPEDITION

Mr. William Beebe, Director of the Department of Tropical Research, of the New York Zoological Society, emphasizes the following items in reporting the progress of the present expedition to Haiti:

1. Three caves have been located and will be visited, in which fossil bones of ground sloths, giant owls and rodents have already been found. One has been explored for four miles, with no end in sight.

2. Fresh-water fish over a foot in length and wholly new to science have been collected in the center of the island and rushed to Port au Prince by airplane so quickly that they were quite fresh on arrival.

3. Remains of Aztec-like sculpture, heads and vases have been found on an island only ten miles from Port-au-Prince. They are exactly like Mexican faces of the Chapala Toltec remains.

4. We have closely followed the bombing practice and after fourteen bombs were dropped on one spot, reaped a rich harvest of rare fish.

5. A survey of all the reefs in the harbor has been made by me in an airplane, and one selected for intensive diving study. Six sharks were seen in one spot from a height of five hundred feet, coral heads as large as automobiles and sea-fans fifteen feet high.

6. We have discovered a breeding place of tarpon in a shallow, sulphur-impregnated, landlocked, mud lagoon, where I took one hundred and fifty, from three to ten inches in length, in five minutes, with a small seine.

Bees Color Blind.—That bees are color blind and that they earn their way about by experience rather than by instinct is the conclusion reached by Profs. S. F. Frisch and Lothar Tirala, German biologists. These investigators have shown that to the bee red and black look alike, orange and yellow look the same as green, and that there is no difference in the appearance of blue, violet and purple.

It has long been known that bees find their way home sooner the longer they have lived in their hive. To test this common sense view bees were put to sleep by ether, taken to a new hive and moved some twelve yards away. None of them could find their way back to the hive until the third day afterward, when 30 per cent. got home. By the eighth day, however, 90 per cent. of them had learned to find their way back to the hive.

PRINCESS STEPHANIE'S BIRD OF PARADISE

*Astrachia stephaniae**

By WALTER GOODFELLOW

AS I recently landed three of these birds over here alive, I have been asked to write something from personal experience about them in their own country, that is among the high mountains of South-east British New Guinea, or Papua as it is now officially called.

This is not the first importation, although it has not been exhibited in the Zoological Gardens (of London) before, for in 1909 I brought over for the late Mr. E. J. Brook no less than seven, comprising four fully adult males and three females. One male died about a month after arrival, but the rest lived for some years: the longest, I think, eight. These two lots, however, are the only ones so far to have left their native country alive, where they live far inland along the tops of steep razor-backed ridges very difficult of access; but more of this later.

Like many of the dark-plumaged Paradise Birds, it is difficult to describe, with the exception of a few fixed colors about the head and chest; it changes color from whichever angle you look at it. Many would think at a first glance that the greater portion is black; but in reality there is little or no real black about it except the primaries. The following is Bowdler Sharpe's description of the adult male:

"General color above olive green of a velvety texture; rump and upper tail-coverts blackish; wing-coverts black with an olive-green gloss; quills black, with a purplish gloss on the inner secondaries; tail feathers black, the inner ones with white shafts, and with a beautiful purple gloss, the edges recurved; head metallic steel green, with a purple gloss; forehead and sides of face as well as the throat and chest glossy emerald-green; ear-coverts more steel blue, but becoming purplish as they form a frill on each side of the nape; sides of neck and a broad band across the chest bronze velvet, with a lilac or purplish reflection; the chest band edged below with fiery copper which separates the breast from foreneck, rest of under surface coppery red with metallic green shades on flanks and abdomen. Total length 31 inches, tail about 25 inches."

I may state here that when one of Mr. Brook's birds died, the tail measured on 31 inches, and that of another 29½ inches. Both were in unusually fine condition. The basal white shafts of the tail feathers mentioned above are a very conspicuous feature of the bird and suggest that it has lost the upper tail-coverts which ought to conceal them. Another and still more striking peculiarity is the way these long and broad feathers blow about, and even in a forward direction under the perch, for all the world as if they were broken at their base or only badly fastened on to the bird. I remember that after Mr. Grönvold had been up to Hoddam Castle to make some sketches of the birds from life, and brought the results back to the Natural History Museum, it was remarked that it was an impossibility for the tail to assume the positions he had depicted. My friend, the late Mr. Ogilvie Grant, drew my attention to it, but I told him it was quite correct, as he himself found out later, and often referred to it.

This species was first described by Finsch and Meyer in 1885, but another imposing looking member of the same genus was known as far back as 1782, but has never yet been brought over alive.

The frills formed by the ear-coverts as described by Sharpe are only seen, however, when the bird displays, and are then one of its most striking features. In captivity the Stephanies are remarkably tame and confiding. They took insects from my fingers within half an hour of being caught. I cannot remember any other species of bird from any part of the world which would do this, except the still more remarkable Meyer's Sickle Bill (*Epimachus meyeri*), which, somewhat strange to say, comes from the same locality as the Stephanie. They are seldom found lower down than 8,000 feet, and there are only two other members of the same family as far as I know found still higher. These are Sir Wm. Macgregor's Paradise Bird (*Macgregoria pulcher*) and Lady Macgregor's Bower Bird (*Loria loriae*). I caught by a fluke one of the latter in 1909 when catching Stephanies and Meyers, and it lived for several years over here. When it arrived it was in olive-green immature stage, but soon moulted out to the adult male plumage. It was a lovely little bird, and almost as tame as the other two when

*Reprinted from The Avicultural Magazine, August, 1926.

Count Raggi's Bird of Paradise, (*Paradisea raggiana*).
Photograph by Elwin R. Sanborn.

caught. *Macgregoria* I have seen alive living as far as I know only on Mount Victoria and the adjacent Range, but I have been told it is a very inquisitive bird, easily attracted by chopping wood or some such sound; so it looks as if it might be as tame as the others, and perhaps far easier to catch. The others keep almost entirely to the highest trees in their region, but there is a time of the year when they come nearer the ground, when the pandanus fruits are ripe. There are many species of these weirdly shaped trees in New Guinea from the coast right up to quite high altitudes, each with a different shaped fruit, some kinds being of an enormous size. All are eagerly eaten by the Paradise Birds in their districts. Some are of a greasy nature, and make the birds very fat while the fruit lasts.

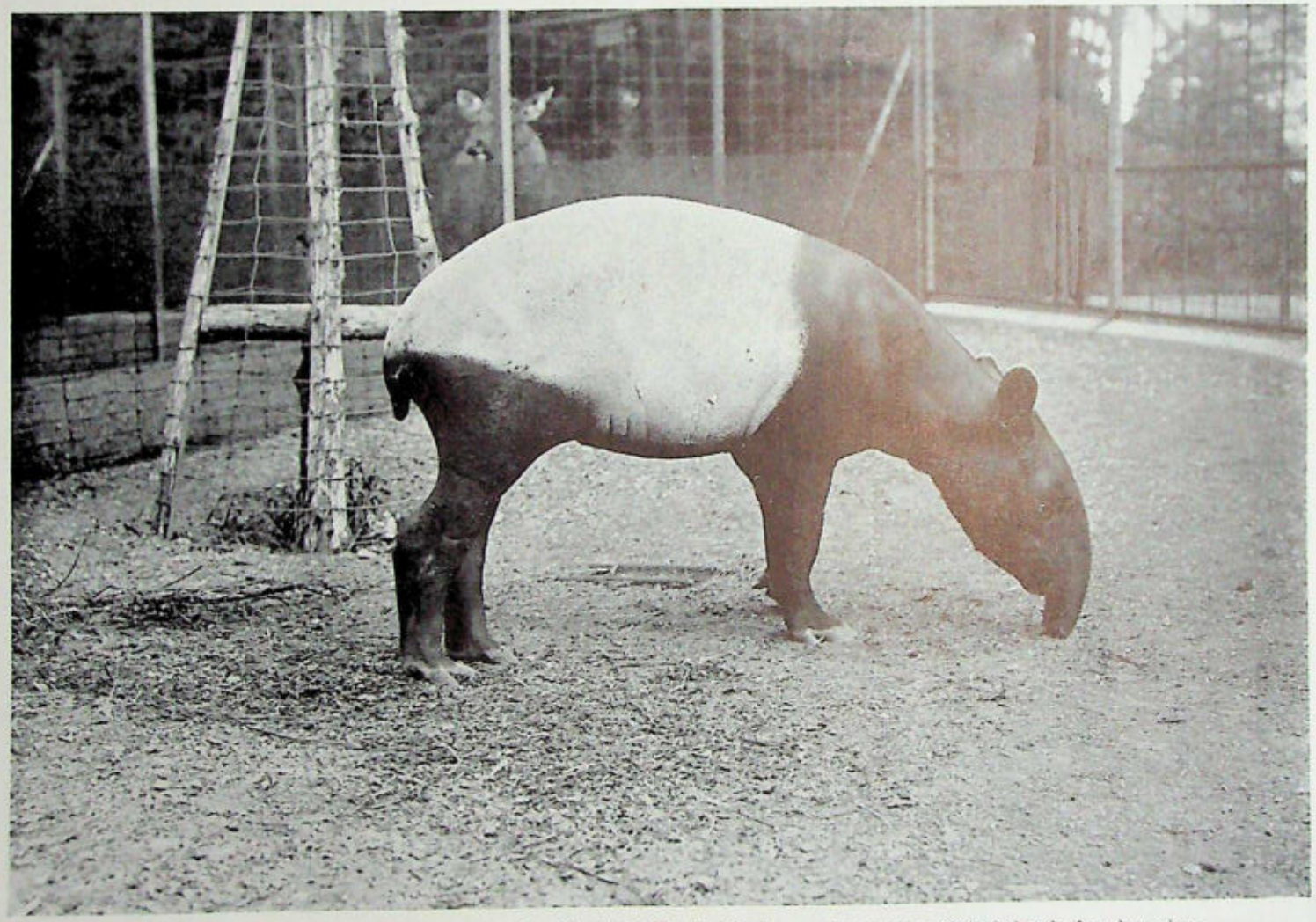
I have found the Stephanies rather silent birds. I cannot remember having heard the three I recently brought home utter one sound during the time they were under my care, which was over four months.

A female built several nests in Mr. Brook's aviaries, and laid two eggs, but both were clear, the male bird at the time being in full moult. It was found to be quite an effort for the males to grow these long tail feathers perfectly; so at that time they received special attention in the matter of food supplies or they were defective in some way. They had access to outdoor flights on almost every day in the year. They much preferred to come out on dull, drizzling, and even foggy days. Their lovely colors are certainly seen to the best advantage out of doors, in fact, only then can they really be fully appreciated. In their own mountains the climate is anything but ideal. There is certainly a short season of clear sunny days, but more often than not it is raw, exceedingly wet, and with spells when the clouds envelope everything in a dense wet fog, sometimes for two weeks at a stretch. It seems strange that living under such conditions the Stephanie and Meyer appear to suffer no inconvenience when brought down to the hot, steaming coastlands; much less so than some of the other Paradise Birds, such as the Superb and Lawe's Six-plumed, which live at a lower altitude. The first I brought home came through the Red Sea during the month of August, when it was exceptionally hot even for that month. The present male in the London Zoo did, however, suffer from the heat one day on the voyage home, and I thought for a time I was going to lose him. It was in Thursday Island, when taking the birds on board the boat for Singapore. Owing to a temporary strike of the wharf laborers, the cages were left standing in an open truck on the pier in the hot sun for nearly an hour. The men would neither move them themselves nor allow me to do so. When they were finally arranged on board I found the Stephanie in a very bad way, and it only recovered after I had placed it in the shade, turned to catch the breeze. I kept it in this position all night, and took my bed up alongside of it to make sure that it was not disturbed by rats, ship's cats, or the crew. The other two never suffered in the same way. This species is much less pugnacious than some of the others, for I remember in 1909, when I ran short of cages, I brought two males over together. This is not advisable, though, for if they do not actually fight, one may be keeping the other from its proper share of the food.

The Stephanies seem to be gregarious and were invariably found feeding in the same trees with the Meyers. They are not rare in their own districts. One reason may be that in the plume-hunting days few of the shooters cared to take the risks of going so far up the mountains with the attendant difficulties of carrying supplies.

I had hoped to have brought home as many this time as in 1909, and I should have done so, but the people I took up with me—Deva Devas—were a truculent lot, adverse, like all Papuans, to leaving their own region; impatient of the cold, so that after three days' stay on the high ridge, and just as I was beginning to get the birds, one discontented man set the others off, and all started on the three days' march back to their homes. I should have been left helpless there had I not returned with them, and no amount of persuasion or bribery would induce them to remain even one day longer. I found afterwards that a series of big dances and feasts in their tribe was the real cause; and although I was still among them after these were all over, I could not get them to go back again.

When I caught my first Stephanies and Meyers on the former expedition, I recall how great was my anxiety as to whether they would feed or sulk. Nobody had ever had one alive before, and the Meyer especially, with its long and delicately curved bill, seemed so ill adapted to cage life. After leaving the first one alone for half an hour, I anxiously returned to peep at the cage, when a glance showed that it had already fed on papayia. I remember my companion (a half-caste Samoan who acted as interpreter) and I killed the fatted calf to cele-



The Malay tapir is the only species of this group found in the Old World. It is known, also, as the saddle-backed tapir, from its curious markings. Photograph by Elwin R. Sanborn.

brate it. The calf in this case, I believe, was a solitary bottle of whisky I had among the stores.

In their habitat these birds never seem to come down into the valleys, but always to keep to the ridges, probably making long journeys in this way. If the fruits on the highest ridges are not ripe, probably those on lower ridges will be. Even after their capture, troubles are by no means at an end, for it is extremely difficult so far in the mountains to get a supply of fruits. It must be remembered that newly caught birds do not take for a long time to the artificial foods we get them to eat over here; so there is little or nothing beyond fruit and live insects to tempt them, and the latter are very hard to get regularly for any number of birds. Then, again, the heart-breaking journey back to the coast, when day after day the poor birds are shaken about on the backs of careless wild savages, who attach no importance to their load whatever; in fact, they cannot understand what interest we see in them, or why we lavish so much care over them, or waste good fruit on them. They are just birds, good to eat, and beyond that they do not appeal to them in the slightest. Again, these carriers are just as likely as not to abandon their loads on the trail, and run off never to be seen again. At certain times during the day the men must all be assembled to give the birds a short rest and time to eat and drink after which, if great watchfulness is not maintained it is more than likely they will turn the cages upside down and start to carry them off again in that position. Probably, too, a suitable camping site may not be reached until long after dark and in pouring rain, when, however tired you may be, poles have to be cut, flies erected to house the cages, and others for ourselves; food cooked, water fetched, and the hundred and one things incidental to a camp. Then it is impossible to start again very early in the morning—I mean at five or six o'clock—as all the cages have to be cleaned, the birds fed and watered, and given a chance to feed, after which perhaps off again in pouring rain. A little wetting more or less is immaterial, however, when rivers and streams have constantly to be crossed. Undoubtedly the most killing parts of all are those appalling razor-backed ranges which run parallel with the coast along almost all the mountainous parts of the country. Almost as steep to climb, some of them, as the sides of a house, and still worse to come down the other side, many of them only a few feet across at the top, in one endless procession. Add now to all this, mud, thorns, stinging bushes, and plants, and almost every known kind of insect pest which never leave one. Some will naturally ask, why go to all these hardships and discomforts just for a few birds? To them I can only answer, I don't know, but something calls one back again and again, although each time I have been to New Guinea, north, south, east or west, I have inwardly vowed that if I got out of the country alive I would never go back again; but I do. Perhaps it is the call back to nature, where it is to be found in its wildest and most savage moods.

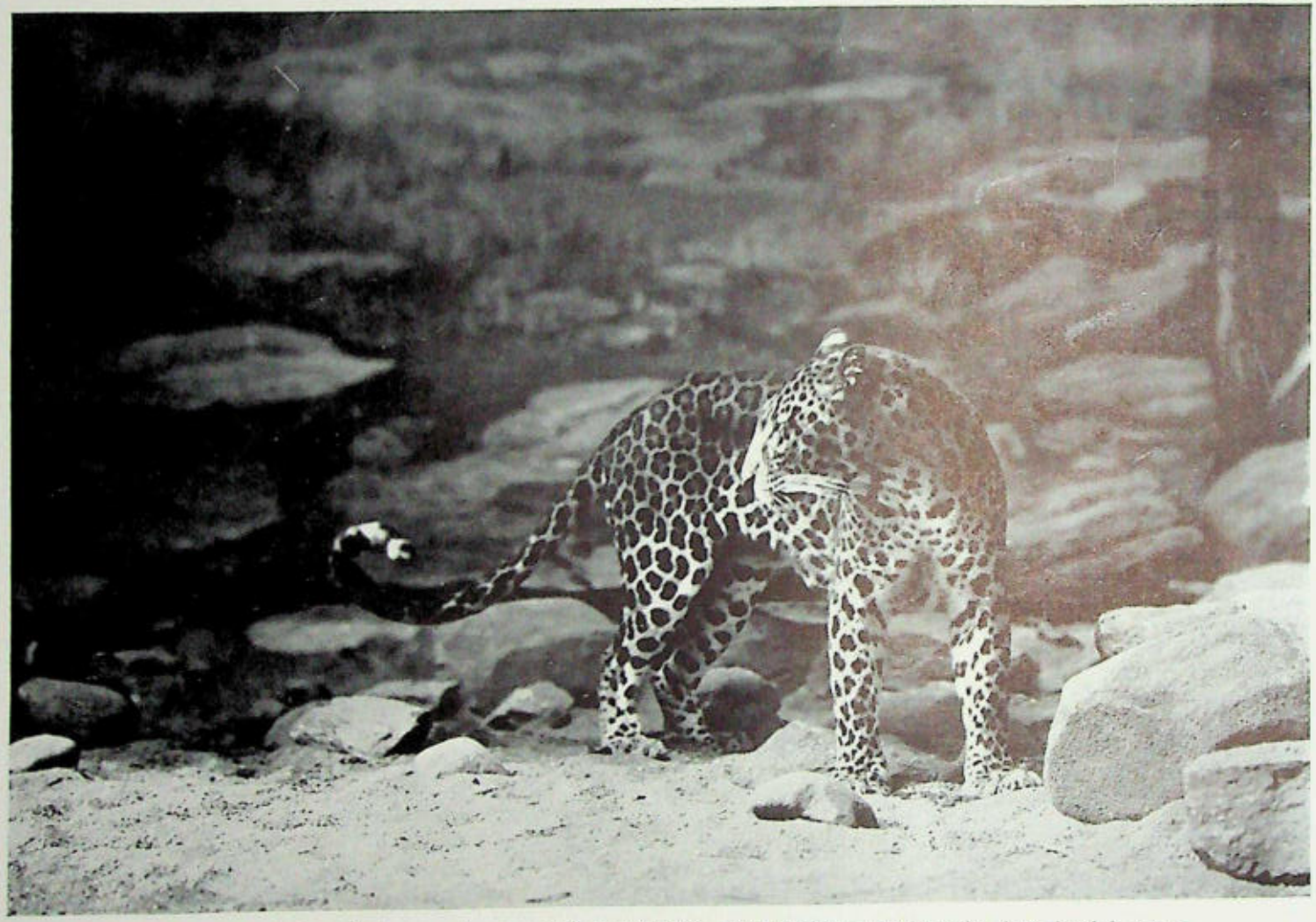
To me the greatest wonder of all is when I look at these New Guinea birds safely housed over here at last, however they came through it all alive; and I can't help standing before them with my mind going back to the inaccessible mountains from which they came, their capture, the anxious moments, the awful camps we had on our march to the coast, the difficulties of fruit supply; the wild, fierce-looking men who carried them, journeys by canoes, schooner, and steamers; the worrying changes en route to England, and many other hardships only too soon forgotten in the comforts of civilization again. But the wonder is still there, and I am the only one who knows it all. Therefore to me they awaken the same thoughts each time I see them and so long as they live with us over here.

MALAY DAYS

(Continued from page 17)

world. Every strand of barbed wire which I cut would gain me a few inches of descent and a score more scratches. I could only defend my eyes with handkerchief-wrapped hand, as I descended that awful round of purgatory, and rested at last, leech-regardless, on the wet moss.

Retrieving my gun, I was fortunate enough to find my bird on the second circle cast; and taking it under my arm, with the jeweled train streaming far behind, I trudged slowly back. I am sure that old-fashioned cupping and bleeding must have miraculous powers, for between the leeches and the thorns I had been thoroughly treated, and no ill effects followed. The following day I had to rest; but when again I made my way through the same jungle, I saw it only as a place of wonder, of keen delight, and of deepest interest.



Next to the tiger, the leopard is the most dangerous carnivore of Malaysia. The black form is simply a color phase, though it appears to be more abundant in some districts than in others. Photograph by Elwin R. Sanborn.

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ZOOLOGICAL SOCIETY BULLETIN
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The great South American condor (*Vultur gryphus*) shares with the California species, distinction as the world's largest land birds of flight. While the wing spread has been reported to be as much as fourteen feet, it is probable that it seldom, if ever, exceeds ten feet.

ZOOLOGICAL SOCIETY BULLETIN

Published by the New York Zoological Society

VOLUME XXX MARCH-APRIL, 1927 NUMBER 2

GREAT BIRDS OF PREY

By LEE S. CRANDALL

MAN'S great regard for the birds of prey is one of his oldest instincts. When our primitive ancestors first raised their eyes from the earth, and watched the soaring flight of an eagle, they laid the foundation for a worship that has never lost place in the imaginations of their descendents. Man's recent conquest of the air is the realization of the dim yearnings of the cave-dwellers. And who can say that this germ of thought, emphasizing the virtues of courage, strength, and love of freedom, have not had their effect on the moral development of our race?

The larger birds of prey fall into two main groups, one containing the eagles and the Old World vultures, and the other the vultures and condors of North and South America. In a general way, these birds may be compared with the flesh-eaters among the mammals. In fierceness, power and courage, the eagles correspond to the great cats, relentlessly pursuing their prey, and overcoming it by sheer strength. The vultures and condors, on the other hand, bring to mind the lowly jackal and hyaena—a rather imperfect comparison, perhaps, but still fairly accurate.

To us, of course, the finest of all the birds of prey is the emblem of our country, the bald eagle. It is the only purely North American eagle and is not found elsewhere than on our continent. This noble bird is not really bald, the name having reference to the white feathers of the head, which can give the appearance of baldness. The adult bald eagle has the tail pure white, as well as the head, these ornaments not being acquired until the bird is three years old. Like all sea eagles, the bald eagle is essentially a bird of the coasts, thought it is found in some numbers near inland waters. Although its food consists largely of fish, the bald eagle is swift and skillful on the wing, when it so desires, and perfectly capable of overhauling such speedy fliers as wild ducks, when in full flight. When food is scarce our eagle is not above robbing the more skillful osprey of its prey, lunging at the lesser bird with such a show of fierceness that the osprey drops its finny catch in its eagerness to escape.

The European representative of the bald eagle, is the white-tailed sea eagle, well known to cross-word-puzzlers as the "ern." The two birds are very similar, the European species being somewhat lighter in body color and never acquiring the white head. The white-tailed sea eagle has a wing-spread of between seven and eight feet, a most impressive expanse. Once fairly common in parts of the British Isles, it has been harried so consistently by game keepers and egg collectors, that now it is found only in isolated sections of Scotland and Ireland, though in the continental portions of its range it still lives in some numbers.

Numerous other sea eagles, many of them handsomely colored, are known from various parts of the world. One of the finest of these is the white-breasted sea eagle, which ranges from India, through the East Indies, to Australia. It is a beautiful bird, clear, pale gray above, with the head and underparts of the body white. Besides its ordinary prey of fish, it is known to feed extensively on the gaudily

To the eared vulture (*Torgos tracheliotus*) must be awarded the palm for ugliness. The bare, livid skin of the head and neck, the wrinkled lappets or "ears," at each side, outdo even the horrid conceptions of the political cartoonists.

colored and exceedingly poisonous sea snakes which abound in the tropical seas of the East.

The most widely distributed of all of the larger birds of prey is the golden eagle, which is found in North America, Europe and Asia. The golden eagle is almost entirely dark brown in color, with a buffy patch on the neck, which gives the bird its name. Young birds show a good deal of white on the breast. The resemblance between the immature bald and the golden eagle is close, but the two species may always be distinguished by the fact that the legs of the golden eagle are feathered to the toes, while in the bald eagle, the feathers end just below the last joint. While the bald eagle frequents the seashores and waterways, the golden is essentially a bird of the mountains. Here it is seen at its best, as it soars among the crags, with great pinions spread to the utmost.

The crested or hawk eagles are found in the tropics almost the world around, and are distinguished by the long plumes which decorate their heads. They are less skillful at soaring than most eagles, but are fierce and powerful hunters, lying in wait for their prey and attacking suddenly as it passes below. One of the most striking of these birds is the crowned eagle of Africa, which is mostly black above, with the breast heavily barred with black and white.

Probably the most powerful of all of the birds of prey is the great harpy eagle, found from Mexico southward to the great tropical forests of South America. While it does not seem closely related to the crested eagles already mentioned, the harpy wears a crown of long, heavy plumes, which it is able to erect or depress at will. Like the crested eagles, the harpy depends on its great strength and suddenness of attack, rather than on speed, in capturing the sloths and monkeys which form the greater part of its prey. The legs and talons of the harpy eagles are of amazing thickness and power, and its grip is one of steel.

The great lammergeyer, or bearded vulture, of Europe and Asia, appears to be a link between the eagles and the Old World vultures, though its closest affinities are probably with the former. The lammergeyer is vulture-like in habits, feeding chiefly on carrion, but so many tales of its aggression have been told, that there seems to be little doubt it sometimes kills living prey. The mode of attack ascribed to this bird is unique—watching stealthily until its intended victim, perhaps a lamb or a kid, has approached the edge of a precipice, the great bird dashes at it with such suddenness that the startled creature is forced over the brink. The lammergeyer then descends to the abyss below, to feast at leisure. There are tales, apparently authentic, of children and even men, having been attacked in this manner.

The Old World vultures are closely allied to the eagles, the most apparent differences being that the heads and necks of the vultures are mostly bare or thinly covered with down, while the feet have little or no grasping power. Their food consists of carrion and while many are large and powerful birds, they probably never attack living creatures.

Of the Old World vultures, there are about twenty forms inhabiting southern Europe, southern Asia and Africa. The largest group is represented by the griffon vulture, of southern Europe and northern Africa. This is a pale, tawny bird, with the head and neck covered by fine, whitish down. Its total length is about forty inches, and its wing spread approximately eight feet. Repeated experiments have shown that vultures have little sense of smell, and the griffon's method of locating prey is typical. An expert at soaring, it circles the air, often at great heights, always with a keen eye to what is transpiring on the earth for miles about. As soon as a carcass or other promising object is sighted, the bird promptly descends in short spirals. This is observed at once by alert fellow scavengers, even though far away. The original discoverer will hardly have assured himself of the correctness of his observation, before the air above will be filled with uninvited guests, eager for the banquet. Before the onslaught of the flock, a carcass as large as that of a horse will be reduced to clean-picked bones in a very few minutes.

The cared vulture, of Africa, is the largest of these birds, measuring close to four feet from tip of beak to tip of tail. The name is derived from a narrow flap of skin, at each side of the head, which is bare, the skin being tinted with sickly reds and purples, giving the bird a most repulsive appearance.

Ranging from eastern Europe, across India and into China, is found the hooded or black vulture. This is by far the largest bird of prey found in Asia, and may well have been concerned in the origin of the ancient legend of Sinbad the Sailor and the great Roc, so prominent in the folk tales of the East. A splendid specimen of this great bird was recently captured in the Altai Mountains, at the western

The head of the male South American condor is one of the most interesting among the birds of prey. Wrinkled and gray as the face of an aged man, it bears a cock-like comb, while the whole effect is softened by a lovely ruff of whitest down.

North American turkey vulture or "buzzard."

border of the Gobi Desert, in Mongolia, by the Third Asiatic Expedition of the American Museum of Natural History. It has been presented to the New York Zoological Park by Roy Chapman Andrews, leader of the expedition.

While resembling the vultures of the Old World in habit, the American vultures are not considered as closely related either to them or to the eagles. The South American and Californian condors are the largest of this group and share the honors as the greatest land birds of flight. I have measured the wing expanse of several individuals of each species and have found them to average about nine feet from tip to tip, although the South American bird is said to attain a spread of fourteen feet.

The South American condor is found on the western slope of the Andes Mountains, ranging from sea level to the region of perpetual snow, far above the sea. It is chiefly grayish black in color, with a white patch on each wing and a collar of soft, white down about the neck. The head is bare and heavily wrinkled and, in the male, wears a fleshy comb like that of a cock, but lacking the points. This ornament is lacking in the female, so that the sexes are easily distinguished.

Like the Old World vultures, the South American condor feeds chiefly on carrion. However, some individuals develop rapacious habits and have become so destructive to the valuable birds inhabiting the guano islands of Peru, that government wardens are compelled to destroy the invaders.

The Californian condor somewhat resembles the condor of the Andes, but the head in this species is bright orange in color and lacks the decorative comb. The story of the California condor is a sad one. North America's largest flying bird has been reduced almost to extinction, the few survivors making their last struggle for existence in the San Bernardino Mountains of California. Gold miners, in the early days, sought the great quills as carriers for the precious dust, and poisoned meat, laid out for wolves and pumas, has nearly completed the work of destruction.

One does not expect to find beauty in a vulture, but the king vulture, of tropical America, excels in brilliant coloration. In the adult, the body is soft, buffy cream, with wings and tail black. The bare head is decorated in rich shades of red and yellow. A fleshy orange wattle hangs from the base of the beak and the whole is set off by eyes of clearest white. The king vulture holds sway over the steaming forests of the lowlands, as the condors do over the peaks. Nowhere really abundant, it is held in great awe by the meaner black and turkey vultures, which keep their distance from the feast until their lord has had his fill.

The female South American condor closely resembles her mate but lacks the comb on the head. The specimen figured is still in the brown plumage of immaturity.

While the majestic condors make a strong appeal to the imagination, the lowly turkey vulture or "buzzard," and the black vulture or "carrion crow" are of the greatest service to man. Both are abundant from our southern states to South America. We of the north, with our complicated systems for the disposal of refuse, can hardly realize the value of these scavenger birds to dwellers in the tropics. It is not too much to say that without the services of vultures, life in the tropics might become a very difficult matter. This fact is thoroughly recognized by the inhabitants and the birds are universally encouraged and protected. There is no better example of coöperation between birds and man, with full benefit to both.

RECORDS OF BIRDS BRED IN CAPTIVITY

By LEE S. CRANDALL

THE successful breeding in captivity of wild birds is the ultimate aim of every aviculturist. In Europe, numerous societies have been formed for the purpose of furthering this object, and several valuable periodicals are devoted to their interests. Medals are given for "first records" and full accounts of the events are published. In America, bird keepers are unorganized, as yet, and reports of breeding successes are difficult to obtain. Two lists compiled by the writer, have appeared in the New York Zoological Society's Bulletin, one in October 1909, p. 580, the other in January, 1917, p. 1447.

Various attempts have been made to bring together the records made in various parts of the world. In "Records of Birds Bred in Captivity," published by H. F. & G. Witherby, 1926, Dr. Emilius Hopkinson has compiled all that are known to date. A total of 816 species is listed, as well as a great number of hybrids, together with full data. Dr. Hopkinson's work now becomes the standard authority in this field and it is hoped that American aviculturists will be stimulated to an effort to take a more important place in future editions.

The two lists previously published in the Society's Bulletin included a total of 124 American records. The list below, covering the years 1917-1926, contains thirty additional species, bringing the number of wild birds bred in captivity in America to 154. The writer solicits reports of successes not already recorded, and in which the young are fully reared.

ADDITIONS TO THE LIST OF BIRDS BRED IN CAPTIVITY IN THE UNITED STATES

1917 - 1926

	BRED BY
GALLIFORMES	
Banded Curassow (*Crax sclateri*)	N. Y. Z. P.
Chinese Painted Quail (*Excalfactoria chinensis*)	Kuser
Satyr Tragopan (*Tragopan satyra*)	de Laveaga
White-crested Pheasant (*Gennaeus hamiltonii*)	N. Y. Z. P.
Cheer Pheasant (*Catreus wallichii*)	Kuser
COLUMBIFORMES	
Scaly Pigeon (*Patagioenas squamosa*)	Noack
Socorro Mourning Dove (*Zenaidura graysoni*)	Gifford
Spotted Turtle Dove (*Spilopelia chinensis suratensis*)	Noack
Red-winged Ground Dove (*Chaemepelia rufipennis*)	Noack
Brush Bronze-wing Pigeon (*Cosmopelia elegans*)	Noack
Plumed Dove (*Lophophaps plumifera*)	Noack
Stair's Pigeon (*Gallicolumba stairi*)	Gifford
Amethyst Pigeon (*Gallicolumba jobiensis*)	Gifford
Buff-hooded Pigeon (*Gallicolumba xanthonura*)	Gifford
Gray-hooded Pigeon (*Gallicolumba rubescens*)	Gifford
RALLIFORMES	
American Coot (*Fulica americana*)	Nat. Z. P.
LARIFORMES	
Silver Gull (*Bruchigavia novaehollandiae*)	N. Y. Z. P.
ANSERIFORMES	
Lesser Snow Goose (*Chen h. hyperboreus*)	Jager
Barnacle Goose (*Branta leucopsis*)	Rockefeller
Magellan Upland Goose (*Chloephaga magellanica*)	N. Y. Z. P.
Paradise Sheldrake (*Casarca variegata*)	Havemeyer
Rosy-billed Duck (*Metopiana peposaca*)	Rockefeller
CATHARTIDIFORMES	
North American Black Vulture (*Coragyps u. urubu*)	N. Y. Z. P.
PSITTACIFORMES	
Peach-faced Lovebird (*Agapornis roseicollis*)	N. Y. Z. P.
PASSERIFORMES	
Diamond Finch (*Steganopleura guttata*)	Williamson
Bicheno Finch (*Stizoptera bichenovii*)	Williamson
Black-faced Gouldian Finch (*Poephila gouldiae*)	Williamson
Masked Grass Finch (*Neopoephila personata*)	Williamson
Sydney Waxbill (*Aegintha temporalis*)	Smith
Black-headed Weaver (*Hyphantornis melanocephalus*)	Worthington

The full names of authorities cited above are as follows: Gifford, E. W., Oakland, Cal.; Havemeyer, T. A., Mahwah, N. J.; Jager, H. J., Owatonna, Minn.; Kuser, Col. Anthony R., Bernardsville, N. J.; de Laveaga, J. V., San Francisco, Cal.; National Zoological Park, Washington, D. C.; New York Zoological Park, New York; Noack, H. R. Oakland, Cal.; Rockefeller, Wm., Tarrytown, N. J.; Smith, Judge Mortimer, Oakland, Cal.; Williamson, T. F. M., Pasadena, Cal.; Worthington, C. C., Shawnee-on-Delaware, Pa.

To Americans, the bald eagle (*Haliaëtus leucocephalus*), represents all that is finest and noblest in the great birds of prey. A purely American bird, it is found from coast to coast, wherever there are great waterways and sufficient seclusion to afford it protection.

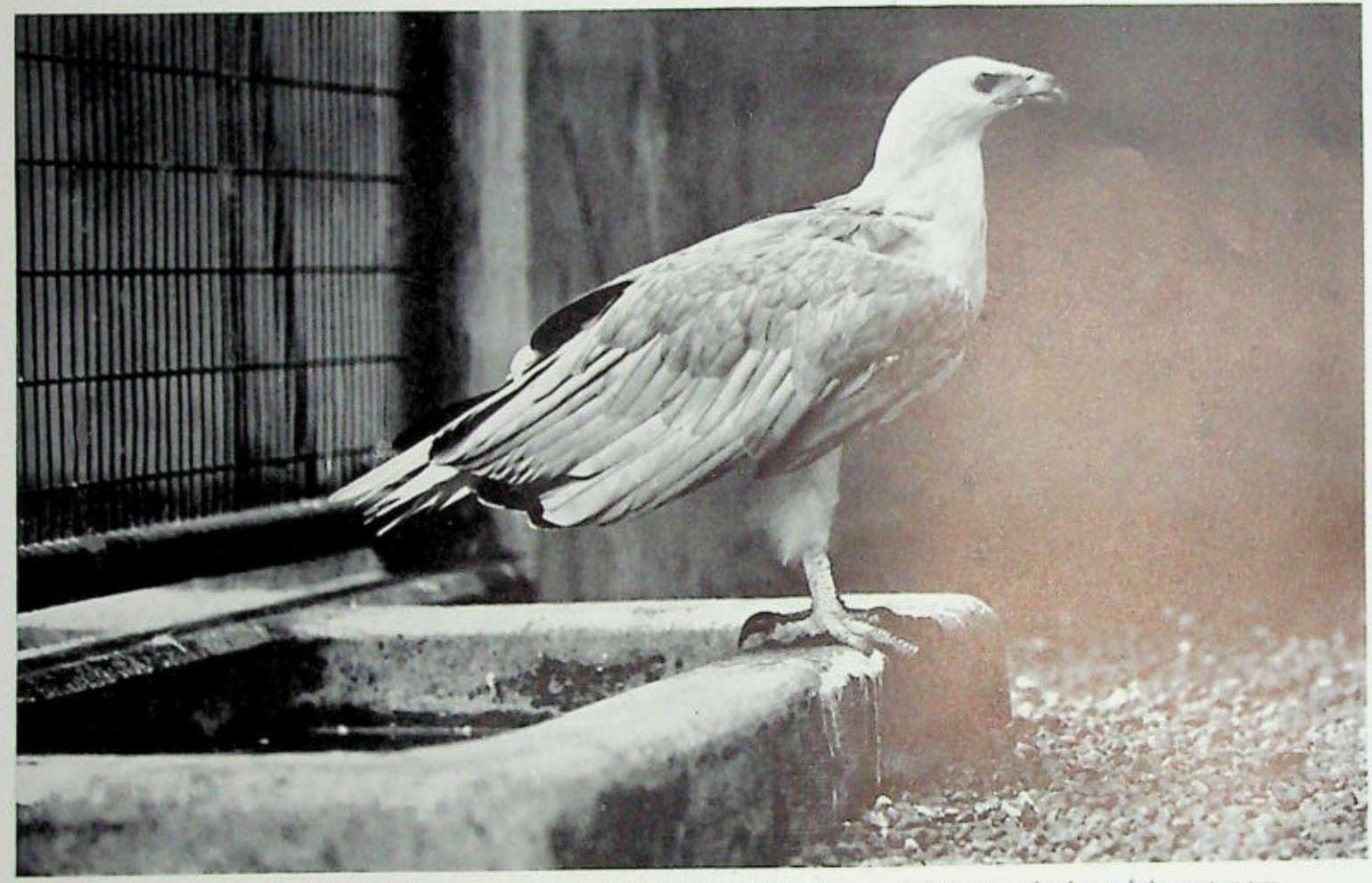
The immature bald eagle closely resembles the golden, but may always be distinguished by the fact that the legs, below the "hock" joint, are free of feathers. The white head and tail are not acquired until the bird is three years old.

Europe's representative of our bald eagle is the white-tailed sea eagle (*Haliaëtus albicilla*). Once common, at least on the northern coasts of Scotland and Ireland, it is probable that not a single living individual is now to be found in the British Isles.

The golden eagle (*Aquila chrysaetos*) ranks among the world's finest eagles. A bird of the mountains, it is found throughout the northern hemisphere, wherever suitable conditions exist.

This fine portrait study of "General," the Zoological Park's first California condor, reveals something of the quiet dignity of the bird. The absence of the comb, and the complete difference in the neck ruff, prevent any chance of confusing the two species of condor.

Life in the tropics might be a far more difficult matter without the help of the black vulture or "carrion crow" (*Coragyps urubu*). Its services as scavenger undoubtedly are a potent factor in preventing outbreaks of disease among the human inhabitants.



In point of beauty, the white-breasted sea-eagle (*Concuma leucogaster*) holds a prominent position. Living near the shores of the great eastern oceans, from India to Australia, it is known to feed largely on the small but venomous marine snakes which abound in those waters.

Fiercest and most powerful of all the birds of prey is the harpy eagle (*Harpia harpyja*) of the jungles of South America. The harpy feeds largely on sloths, monkeys and fawns.

Typical among the heads of the Old World vultures, is that of the griffon (*Gyps fulvus*). The soft down with which it is covered, is undoubtedly an adaptation to the bird's feeding habits.

Smaller than the general run of eagles, the African crowned eagle (*Stephanoaetus coronatus*) makes up in strength and ferocity what it lacks in size. This pose is typical of the bird's aggressive nature.

The Griffon vulture (*Gyps fulvus*), in its various forms, is probably the most abundant of the Old World vultures. This particular specimen, still living in the New York Zoological Park, is our oldest bird inhabitant, having been received on August 23rd, 1902.

Once abundant in the Alps of Europe, the lammergeyer or bearded vulture (*Gypaëtus barbatus*) figures in many stories and legends. Its gruesome habit of driving lambs over cliffs, later to descend and feed on the remains, is well authenticated.

North America's largest bird of prey is the California condor (*Gymnogyps californianus*). Unfortunately, this fine species is now very close to extinction, and appears to be confined to a small area in the San Bernardino mountains of California.

The king vulture (*Sarcorhamphus papa*) is one of the few birds of prey possessing really brilliant coloration. The head, neck and beak are a blaze of red, orange and yellow. This specimen is a young male, just acquiring the soft, creamy body plumage of the adult.

New York Zoological Society

OBJECTS OF THE SOCIETY

¶ A PUBLIC ZOOLOGICAL PARK. ¶ A PUBLIC AQUARIUM. ¶ THE PRESERVATION OF OUR NATIVE ANIMALS. ¶ THE PROMOTION OF ZOOLOGY.

ZOOLOGICAL SOCIETY BULLETIN

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Departments:

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Aquarium — Charles H. Townsend
Birds — Lee S. Crandall
Mammals—Reptiles — Raymond L. Ditmars

William Beebe
Director, Tropical Research: Honorary Curator, Birds

Each author is responsible for the scientific accuracy and the proof reading of his contribution.

Members of the Zoological Society are entitled to all publications, Reports, Bulletins, Zoologica, etc., (Zoologica mailed by request only) and no effort will be spared to ensure their delivery. Changes of address, forwarding points and non-delivery of mail should be stated promptly. Contributions pertinent to the objects of the Bulletin cordially welcome. Stamped and return envelope should accompany communications. Address Editorial and Subscription Offices, Zoological Park, New York City. Elwin R. Sanborn, Editor.

Vol. XXX March-April 1927 No. 2

NEW MEMBERS

In maintaining two great institutions, such as the Zoological Park and the Aquarium, one of the first and foremost requisites is public support in the form of a large membership. The importance of the annual member in this connection can hardly be overestimated. Recognizing this fact, the Zoological Society is seeking to enlarge its membership to six thousand, in order to extend and increase its usefulness in an educational and scientific way.

Since the city does not provide appropriations for the purchase of animals and other exhibits, or for the carrying on of field work, or the publication of the Society's scientific researches in different parts of the world, it is necessary to secure additional funds for this purpose in order to overcome the limitations arising from the lack of an enlarged equipment and endowment.

The dues of the members may therefore be regarded as contributions to a great educational and scientific cause, and it is partly on that basis that we are urging the members of the Society to aid in the securing of new members.

With such an increase in membership, the additional income would enable the Society to develop new lines of work through the establishment of lecture courses, the issuing from time to time of important natural history publications for the special benefit of its members, and the promotion of researches along certain scientific lines in both the Park and the Aquarium.

The recent alterations at the Aquarium will greatly increase the laboratory facilities for demonstrating the many kinds of small marine invertebrates to the school children of New York who visit the Aquarium with their teachers. Additional facilities will also be afforded for students of our universities who may desire to carry on marine biological investigations.

As a scientific organization the Zoological Society has contributed to the natural history education of the grammar and high school students to the limit of its resources, but in the near future far more should be done to meet the growing demands for lectures and demonstrations in the regular school courses in natural history.

Among the many advantages of membership in the New York Zoological Society are first of all the satisfaction of taking part in a great popular enterprise of the utmost interest to every lover of Nature, and of encouraging the systematic study of animal life, or zoology, and the promotion of zoological science generally.

The direct benefits to members are admission to the Zoological Park on the two pay days each week when exhibits may be seen to the best advantage; the privileges of the Administration Building, the library and the picture gallery; admission to all lectures, receptions and special exhibitions, and complimentary tickets to the Zoological Park, for distribution among their friends. Members also receive all the publications of the Society, including the *Zoological Society Bulletin*, which is published bi-monthly and contains popular news and information concerning the Zoological Park, the Aquarium and the Tropical Research Department, as well as articles relating to other of the Society's enterprises of general interest to the members.

The subscription price of $10.00 a year is not a serious matter, and if each of the present members would obtain one new member, our goal would quickly be reached. If the members of the Society would endeavor to interest their friends and make them familiar with the aims of the Society, they would be rendering a fine service by promoting a wider knowledge and study of animal life. *W. R. B.*

New York Zoological Society

OBJECTS OF THE SOCIETY

A PUBLIC ZOOLOGICAL PARK ~ A PUBLIC AQUARIUM
THE PRESERVATION OF OUR NATIVE ANIMALS ~ THE
PROMOTION OF ZOOLOGY

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ZOOLOGICAL SOCIETY BULLETIN

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The courtship of the Spotted Salamander (*Ambystoma punctatum*). Based on color notes, photographs and measurements as witnessed about 11:00 P. M., April 8, 1926. Painted by F. L. Haques. Note the slate color of the under side of the individuals which is much lighter than at other seasons. Note the spermatophores showing as white dots scattered about the floor of the pool.

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THE COURTSHIP OF THE SPOTTED SALAMANDER

By RUTH B. BREDER

IN a small marshy area in South Mountain Reservation near Millburn, New Jersey, the writer for a number of years past has observed the appearance each spring of quantities of the egg masses of a certain amphibian. These were known to be deposited by the spotted salamander, *Ambystoma maculatum* (Shaw). A search of the literature, revealed relatively little information on the details of the manner of reproduction of this species. A summary of the knowledge on the subject up to this time ran somewhat as follows:

In the very early spring the adults would leave their hibernating quarters and migrate to certain pools, where they would mate and lay their eggs. The rest of the year was spent in such seclusion, that to find an adult after the breeding season, was most unusual. The mating of single pairs had been observed in the laboratory by Dr. A. H. Wright of Cornell. The males were seen to deposit a number of milky white capsules known as spermatophores, each of which contained countless numbers of spermatozoa. At least one of these was picked up by the female and subsequently served to fertilize the eggs. These data, with an observation also made by Dr. Wright of droves of the salamanders migrating "even over car tracks in an effort to reach their breeding grounds, many being killed by the passing cars" were the essential points then known about their breeding habits.

In the spring of 1926 I decided to make a determined effort to observe and study the actual mating in the field of this large and handsome species. I had noted in former years that prior to the actual egg laying, a close scrutiny of the proper pools always showed an abundance of the milky white spermatophores which had been neglected by the females. The first appearance of a few of these capsules indicated that thereafter, nightly visits must be regularly made if results were to be obtained.

With this foreword let us now retrace the journey of the tenth such night; April 8, 1926.

Arriving at the Millburn railroad station, Mr. Breder and myself alighted and treked along the familiar bridle path that led to our destination. A chilling drizzle of rain had started which the beam of our flash light penetrated with difficulty as we slipped and splashed along through the early spring mud. Surely, I thought this was an unprepossessing evening for even a salamander. As is his wont, nodding noncommittally to such observations my side partner trudged along, silently smoking. As we approached the pools which every previous spring had contained eggs, he stopped to get the camera and other paraphernalia in readiness for use, should we need it, and for this reason I preceded him to the pool's edge where after one or two failures, I finally induced my flash light to stay on. The beam lit up a patch of the woodland pool, the surface of which the rain pellets were dimpling and there as though behind a hazy and rippling curtain lay the reward of persistence. Such a sight—not a few scattered pairs as I had been led to expect but huge squirming masses of handsome brutes entirely engrossed in their courtship.

I quickly called but my companion was already at the pool's edge silently observing and drawing on his pipe too absorbed to comment.

Together we counted in this one pool five distinct aggregations, each of at least forty or fifty individuals. The bodies of the females were clearly distended with eggs and of a light grey color below while the males, on the other hand, were slighter in build and of a more brilliant hue and showed more nearly the typical darker under surface found at other times of

Four stages in the courtship of the spotted salamander. The spermatophores may be seen scattered about the bottom of the pool

year. Their activity and numbers was in great contrast to their sluggishness and solitude at other times. The details of this will be described in a technical paper now in preparation.

After recovering somewhat from the excitement of having all this under our gaze at one time our first thought was to determine the range of activity, and we accordingly visited what in our note books were known as ponds "B" and "C" as well as the adjoining territory and millpond. Here we found that the conditions were practically identical. Casting the light about the ground at our feet other hordes were seen descending to the pools, so close and in such haste that we had to exercise care to avoid treading on them. On this memorable evening literally thousands of individuals were seen. By eleven o'clock the last of them had arrived and their good sense of direction invariably led them to swim directly to the nearest aggregation and from there on to the more distant units. By this time the peak of activity had been reached and only a few stragglers were out of the water. Here and there on the bottom groups of neglected spermatophores were beginning to become prominent. We, of course, ordinarily associate noise with the breeding activities of frogs and silence with that of salamanders, but in this case the activities were accompanied by a weak but distinct sound. The constant rising to the surface for air and the consequent breaking of small bubbles as they gulped it produced a continuous hum which although audible only a short distance was clearly heard above the patter of the light rain. Our good fortune in finding this great center of activity was to some extent offset by its very magnitude, in that it prevented any detailed study of individual acts because of the constant coming and going and the general confusion. We tried in vain to record this conclave photographically and were forced finally to give up when the sputtering and damp explosive flashlight powder seared Mr. Breder's wrist. However, copious notes taken at the time enabled us to reconstruct the scene as here presented.

So optimistic were we that the scene would be repeated on the next night that we gathered only fourteen of the specimens on the embankment, not wishing to disturb the conditions in the pools and returned home, no longer noncommittal or wearied. Indeed the rain which

The unusual spermatophores as they appear in early spring.

had been increasing in volume and now at midnight was torrential was almost forgotten and anyway we had been long since completely saturated.

The next morning with the confidence of the enlightened I called up Dr. Noble of the American Museum of Natural History and although his opinion was that the chances were against it he accepted my invitation to visit the pools. Accordingly the next evening found Dr. Noble, Mr. Weber, Mr. Breder and myself starting out as on the previous night. Dr. Noble was right and we were doomed to disappointment. The activity of the previous night was over,—and the hordes had vanished. Only after the most energetic netting in the leaf mold bottom of the pools did we locate three specimens, and the abundant excess spermatophores alone remained as mute evidence of what had been seen the night before.

We believed that this great and sudden exhibition of breeding activity did not occur normally, and the interpretation was somewhat as follows. The chilly spring of that year held back the activity longer than usual, that is, dammed it up. Then when the temperature rose to the proper point in the water it burst forth intensively giving us the opportunity to witness this remarkable spectacle. On account of the appearance of spermatophores in previous years we have reason to believe that usually the activity is much less intense on any one night and is drawn out over a more or less protracted period.

However, this spring, 1927, Mr. and Mrs. Rudyard Bolton of Cold Spring Harbor, New York, have had the good fortune to see a similar spectacle. Judging from Mr. Bolton's description of the activity it was probably even greater than that

The eggs as they appear in a natural pool.

Two types of egg clusters, clear and cloudy.

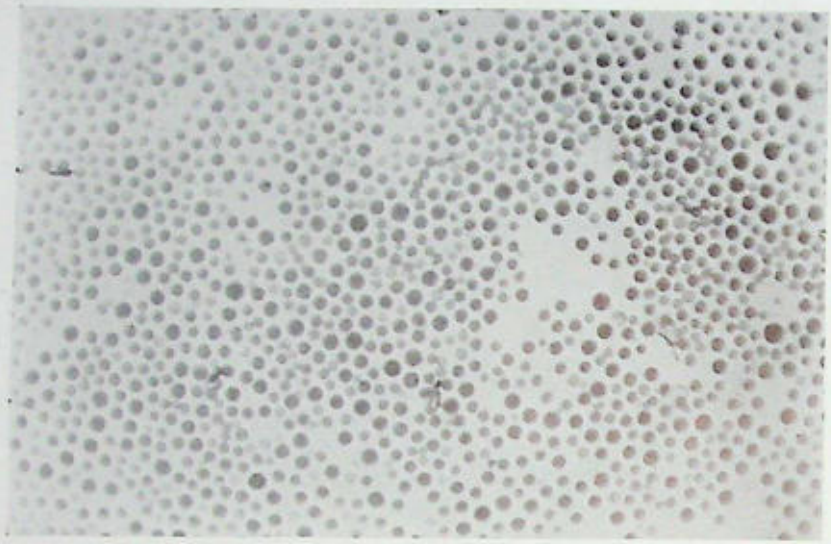
Two partly cloudy egg clusters.

observed at Milburn. As the advance of this season was quite different from that of the last other factors may be involved and the hypothesis just mentioned may prove invalid. It is interesting to note that in the Millburn observations the males only slightly outnumbered the females, but in the Cold Spring Harbor mating they were many times more numerous than the females. This year Dr. Noble visited the Millburn locality on a rather unfavorable night and collected about one hundred specimens out of which only a few were females. I interpret this to mean that the males probably precede the females to the pools and that these two observations of this year were made at a time when the full complement of females had not yet arrived.

Be that as it may as late as April 21st, 1926, with a temperature of 56° out came the few last laggards which behaved in much the same manner as previously described, with the exception that the groups were all smaller and more scattered. However, this gave us the opportunity to observe some of the detailed individual acts which had been impossible in the first instance on account of the great numbers of salamanders. It also made possible the successful photographing of a number of interesting poses. To those who are not familiar with the technique it should be pointed out that night photography by means of a hand flash light is difficult at best and the focusing on moving animals under three or four inches of water in a woodland pool and in addition making a successful exposure through the water's surface, all greatly complicate matters. The animals, too, especially on this last night gave evidence of being considerably disturbed by the flash light but we presently found that by waiting in darkness for a short time they would soon regain composure and resume their amarous activities.

On April 14th, we had the pleasure of having with us in the field Messrs. D. R. Carter and C. K. Urner and it was the latter who can claim the distinction of being the first to find a female in a state of nature in the act of depositing her eggs. There was little mating this night and nearly all specimens were females about to or

A cluster of eggs hatching in the laboratory. Note the four hatched larvae.



Photomicrograph of the bright green algae which in many cases surrounds the egg membrane in a single layer, as here shown, and imparts the characteristic color to it. Magnification x 13.9.

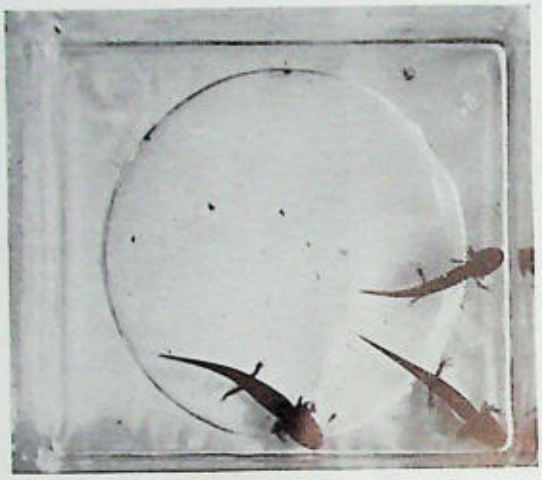
having just completed the act of depositing their spawn. They did not appear to be very particular as to just where they dropped their eggs, some even laying them in our collecting bags, apparently being unable to retain them beyond a certain time.

About twenty-five masses were laid at home or in the New York Aquarium and consequently we had many larvae both from these and other egg masses collected from the pools. These masses when laid in their natural state are very attractive being generally of clear gelatin usually with a green algae growth about each embryo. This may occasionally be absent and in such masses the black pigment of the developing salamanders shows distinctly. Some of the masses are milky, which almost entirely obscures the eggs proper. The causes for these differences is not quite clear although apparently all yield normal and healthy larvae. The cloudy masses were found to be full of microscopic cubic crystals which are doubtless the cause of the milky appearance. In the laboratory we found that the eggs containing algae would not hatch in the dark while those without it readily did so, and that the cloudy masses, if containing algae soon died with even a slight diminution of light.

This probably means that the algae helps provide oxygen for the developing embryos in the presence of light and robs them of it in darkness. These details are now being studied. The actual weight of egg masses on deposit may be from one to three grams at most while the females weigh from fifteen to twenty grams. The eggs swell rapidly by the absorption of water and may reach about two hundred grams in a few days. The development of these eggs under controlled laboratory conditions, their changes in weight and the growth of the young, is another story which cannot be gone into at this time.

In confinement, I found the larval salamanders metamorphosing, losing their gills and acquiring the yellow spots of the adults, in Sep-

Site where most of the observations were made. The prone log is the same one as that in the color-plate frontispiece.



Larval *Ambystoma maculatus* collected from these pools on July 12, 1926.

tember when they take up life on land, and then resemble their parents in all essential respects.

A Lungfish at the Aquarium—The aquarium is exhibiting its first lungfish—a gift of the London Aquarium. The specimen—*Lepidosiren paradoxa* from South America—is about three foot long, dark gray with diverging brown lines about the head. It has a small mouth and very small blue eyes. *Lepidosiren* is a common food species in Paraguay and peculiar in several respects. The air bladder serves as a lung and the fish rises frequently to the surface for air. A more detailed description will appear in a future issue of the BULLETIN.

THE GROTESQUE LUMP-SUCKER

(*Cyclopterus lumpus*)

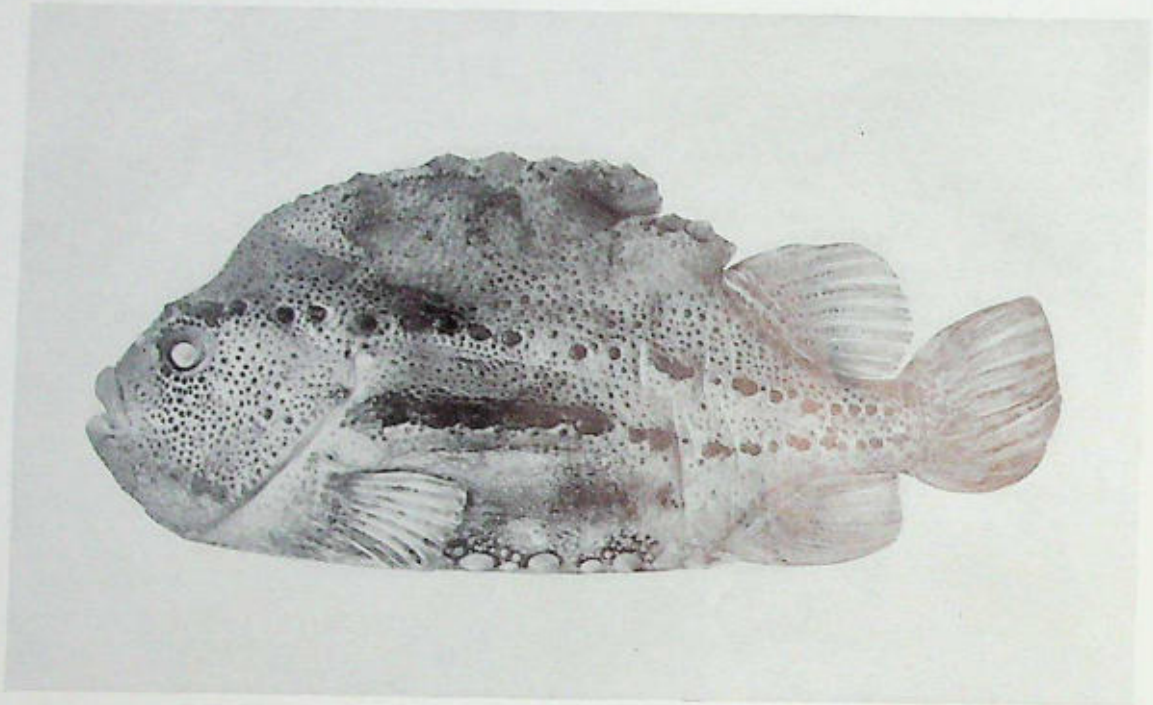
By C. H. TOWNSEND

MODERN deep-sea exploration has revealed the existence of so many kinds of strangely-shaped fishes in great depths, that we often overlook the presence of such fishes in shallow water. One of these, the Lump-sucker, meets all the requirements of what constitutes the fantastic and the bizarre. Although found at times along the coasts of Long Island, specimens seldom reach the Aquarium. The last one received was not alive, but being a rather large adult, we made the photographs shown in this number of the BULLETIN. The Aquarium misses many an interesting specimen because the fisherman does not handle it carefully, and the fisherman misses a fee that would repay him for his trouble. None of the lump-suckers brought in were in condition to live longer than a few weeks.

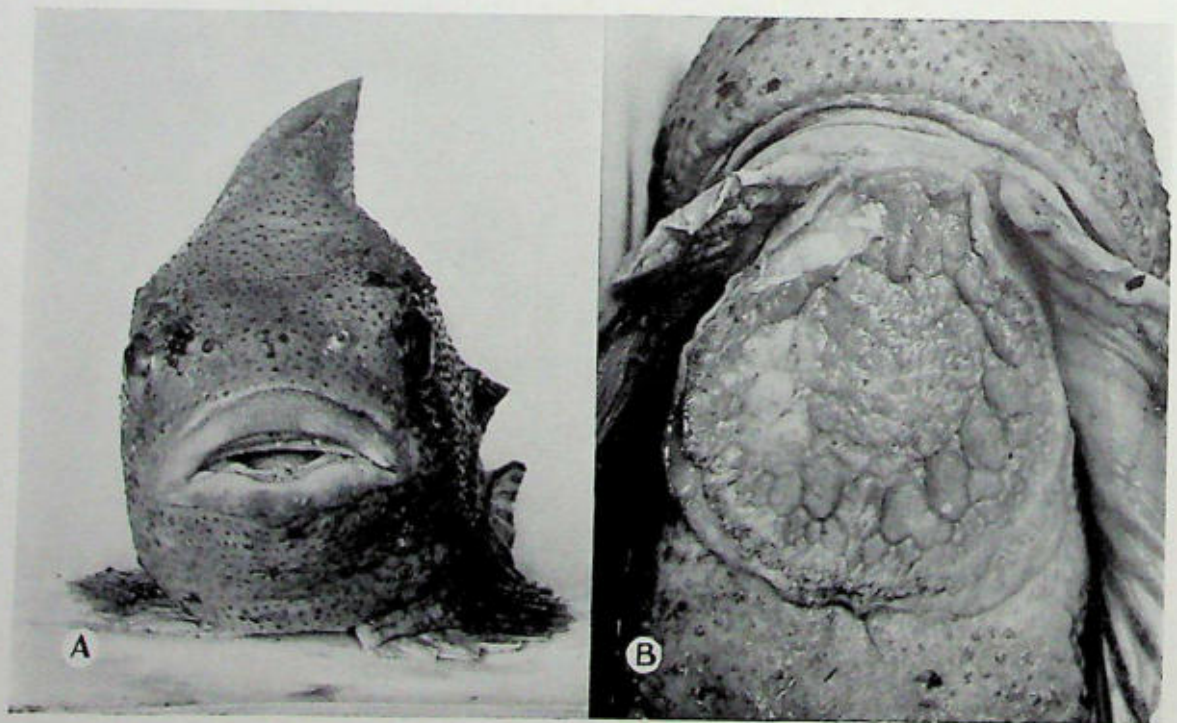
The Lump-sucker inhabits the northern coastal waters of both sides of the Atlantic, seldom being found south of the latitude of New York. It reaches a weight of about twenty pounds and a length of ten or twelve inches. It is called Lump-sucker because of the large sucking disk on the throat, with which it clings to the stones among which it usually lives. It has been described as carrying its anchor under its chin. In a large specimen, the sucking disk is about two inches in diameter. When the disk is cut off and laid on a wet board it clings tightly. The live fish attaches so tightly to the inside of a pail of water that when lifted by the tail, bucket and all may be raised from the floor. The sucker is formed of the throat fins, which are united in front. This odd fish is not well known except to fishermen. Buckland saw one in a London fish market labeled "King-fish from Japan." The dealer told him that people asked so many questions about it that he had to give it a name that would satisfy them, saying "Of course I know well enough, it's nothing but a jolly old lump-sucker." At spawning time early in the spring, the lump-suckers move into shallow water along shore. After the female which is larger than the male, deposits her eggs, the male drives her away and takes charge of the nest until the eggs are hatched. He keeps his head close to the mass, constantly opening and closing the mouth to keep a current of water through them.

The egg masses are sometimes deposited so close to the shore that the guardian has been left half stranded at low tide and forced to lie on his side twice a day until enough water returned to float him. He holds his position faithfully in spite of all difficulties. When removed a couple of yards away, he wriggles painfully back through the shallow water to his charge. One observer found that when heavy waves washed the egg masses of the lump-suckers from their positions, and the sea became calm, the anxious males were moving about seeking their lost bunches of eggs. When half stranded during the spawning season, they are sometimes attacked by crows and other predatory birds.

The behavior of the male lump fish in captivity when caring for the eggs has been observed twice by Dr. Kerbert, director of the Amsterdam Aquarium. The mass as deposited has some holes through it which aid the fish in his water circulating task. He defends his



The lump-sucker, a bizarre and fantastic fish sometimes found on the Long Island shores.



A. Front view of the head of the lump-sucker.
B. Throat of lump-sucker showing the sucking disk.

treasures furiously during the whole process of hatching which lasts about twenty-seven days. Millions of young are to be seen later in the tank. They cling quickly with the sucking disk to whatever is available. In spite of its soft lumpy body and stubby tail the lump-sucker manages to swim very well.

The lines of horny tubercles which are so prominent in the adult fishes, develop very slowly in the young. The tubercles represent about the only firm spots in the make-up of the lump-sucker. The body as a whole is as soft and tremulous as a mass of jelly, especially in the young. Even the bones are cartilaginous. There is much variation in color among lump fishes. The female is usually very pale greenish, the male at breeding time being more showy, with shades of pink, blue or purple above and orange below.

It is recorded that the lump fish is used for food in Greenland, and sometimes in the north of Europe.

Aquarium at Monaco: Main corridor of the Oceanographic Museum.

THE OCEANOGRAPHIC MUSEUM AND AQUARIUM AT MONACO

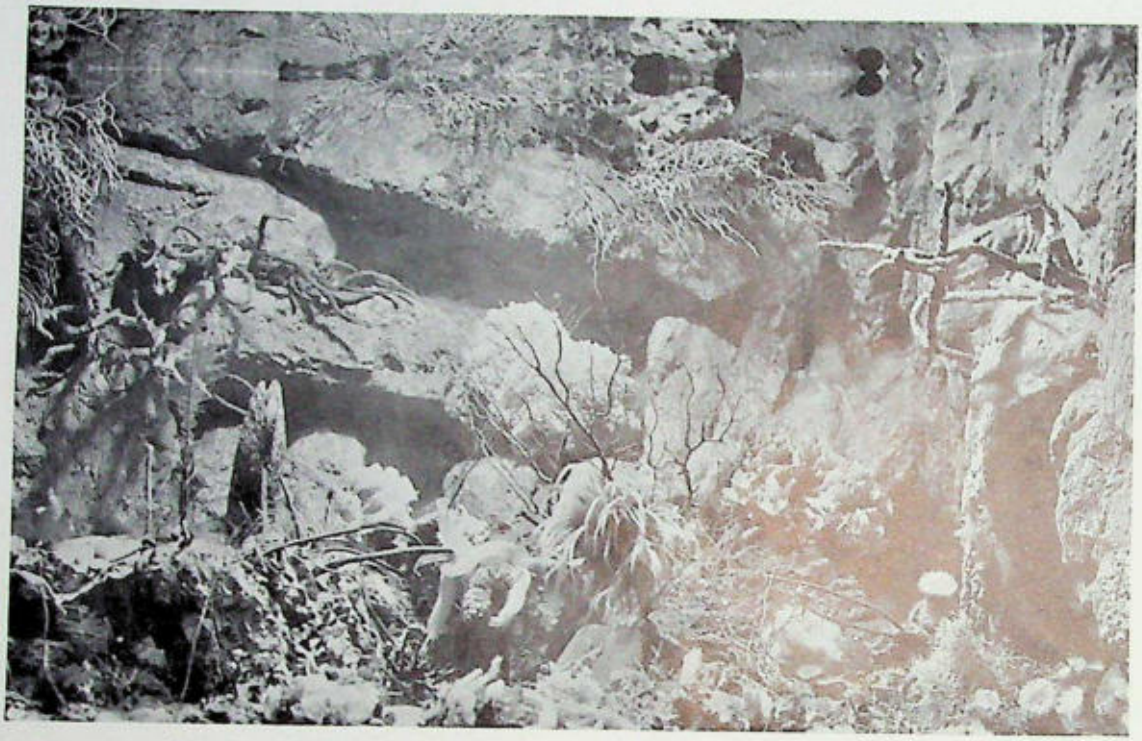
In reply to a request of the Director of the New York Aquarium, Dr. J. Richard, Director of the Oceanographic Museum at Monaco, sends the following descriptions of the Museum and the Aquarium. It is regretted that part of the interesting article on the Aquarium prepared by Dr. Oxner, and some of the photographs had to be omitted for lack of space. It is possible that there are deficiencies in our translation.

—*C. H. T.*

THE Oceanographic Institute, consecrated to the science of the sea and founded in 1906 by Prince Albert I of Monaco, is an independent institution, of public utility, recognized by the French Government. (Presidential decree of May 16, 1906).

Its government is by an administrative council, its scientific direction is under a "Comite de Perfectionnement." (Prince Albert I died the 26th of June, 1922.)

The Oceanographic Institute consists of an establishment (inaugurated Jan. 23, 1911) situ-



Aquarium at Monaco: There are twenty-two different species of sponges in the tank.

ated in the University quarter of Paris where instruction is given by means of lectures and conferences, and in the other part, of a Museum situated at Monaco on the sea coast, provided with an aquarium, working offices, laboratories and superb collections. The little steamer *The Eider*, given to the Museum by the Prince, permits the students of Oceanography and foreign scientists to familiarize themselves with the methods of sea work or to follow special research.

The Oceanographic Museum is an imposing building placed upon the top of the Rock of Monaco. It measures 100 M in length and is constructed entirely of Turbic stone. Two groups ornament the projecting front of the structure. These groups from the chisel of the sculptor M. Dussart are 8 M in height and represent: at right, Truth unveiling to Science the forces of the world; to the left, Progress coming to the succor of Humanity.

It was inaugurated in 1910 in the presence of notables of the Scientific and political world from all countries. It contains six great halls, the large aquarium and many laboratories.

The parts of the Museum accessible to the public are: the ground level, the first floor, and the aquarium which is under ground. In the centre of the ground floor is the Salon of Honor with the Statue of the Prince. At the right (west) the committee room; to the left (east) is the room of Oceanographic Zoology containing above all the collections of animals from the great depths of the sea made by the Prince of Monaco. On the first floor: the great central hall with the laboratories of the yacht *Hirondelle II* reconstructed in memory of the cruises of Prince Albert I. To the right (west) the hall of applied Oceanography; industries of the sea, pearls, corals, fish scales, artistic applications of fish, etc. To the left (east): the hall of physical and instrumental oceanography; apparatus for analyzing the water, measuring the penetration of light, temperature, depth, currents, tides, nets for the scientific exploration of the sea. The underground floor: the aquarium peopled with numerous, interesting marine animals. Numerous explanatory labels in French, Italian, German and English have been placed for the most interesting subjects. Many are accompanied by illustrations.

Here are above all representatives of the fauna of the depths which give to these collections an inexpressible value. The devices of the Prince have worked successfully to a depth

Aquarium at Monaco: Gorgonian corals, sea squirts and marine worm.

Aquarium at Monaco: Gorgonian corals, sea anemones, egg masses of mollusks and other forms.

Aquarium at Monaco: A tank in the aquarium showing five species of sea urchins.

of 6000 M. We must say at once that these collections are not complete because a great part may still be found in the hands of the numerous collaborators. As the preserved animals are often deformed and discolored, they are placed when possible, beside reproductions in black or in colors, which permits a better comprehension of the animals and gives some suggestion of their coloration when they reached the light of day. It is to this end that the Prince took with him artists. The colors of these animals disappear when they are captured.

Aquarium of the Oceanographic Museum at Monaco

Abridged from an article by Dr. M. Oxner.

The Oceanographic Museum was inaugurated in 1910. Since then the Aquarium connected with it has enjoyed great popularity, the public finding there both pleasure and information. By 1924 the Aquarium had doubled in size and in 1925 "submarine landscapes" were created in many of the tanks. There are forty-nine tanks in all, making it the largest marine aquarium on the continent. It is not the number or the size of the tanks which constitute the value and reputation of the Monaco Aquarium. It is as satisfactory to the public as to the scientists. A placard in front of one of the first tanks asks "Why should one visit a marine aquarium?" The reply is: "An aquarium is a vivarium: it presents to the observer healthy animals in full vigor; the conditions of life in captivity (clear water, good aeration, the company of other species, proper temperature, light and nourishment) are adapted to reproduce as far as possible natural conditions." One thus succeeds, as in the case of the Monaco Aquarium, in keeping living animals from five to fifteen years. This is proof that the animals find satisfactory living conditions in such an aquarium.

The observer who seeks information or simply wishes diversion, has only to look attentively to discover the most complicated phenomena. There is extreme variability of form and color of different species; the form, size and position of eyes, mouth, fins, etc.; the characteristic movements of each species; the character of movement varied with the impulse of the animals, such as attack, defense, pursuit or flight; the peaceful attitude of some and the agitation of others; the instinct of ruse, hiding and

camouflage; the formation of new habits among individuals who have lived long in the aquarium.

There is no end to the facts that may be observed by the visitor, who thus finds his conceptions of life enlarged.

The specialists of the Monaco Aquarium do not show to the public a multitude of animals renewed each week. The object is to keep the animals healthy and vigorous for many months. Many of them live for years. The Aquarium is intended to be a vivarium of the Sea. Delicate species whose habits are not yet known, may live from six months to a year. In tanks not shown to the public, the specialists of the Aquarium study numbers of rare species each year.

The fishes are neither the most interesting nor the most beautiful among marine animals. In the tanks at Monaco one sees a multitude of invertebrates. There are anemones of twenty or more species, sea-stars of ten or twelve kinds, sea cucumbers, a throng of crustaceans, large and small mollusks, among them the purple Murex of the ancients—the source of Tyrian dye, corals, tunicates, sponges of many species, marine worms and many other forms from the sea bottom.

The collections of invertebrates are made largely with the dredge or trawl. They are displayed with much of their natural surroundings, so that they may be seen as they lived when at liberty in the sea.

There are twenty-one tanks devoted to these submarine settings. The first was installed in 1912. An important enlargement of the Aquarium was affected in 1924, when the others were added. These little living communities of the Sea have been as successful with the public as with the artists and scientists who visit them.

That the scientists at Monaco have not failed in successfully reproducing the submarine groups of sea life, one has only to walk through the mysterious gallery of the Aquarium with eyes closed, and listen to the remarks of visitors from all countries speaking in all languages.

THE GIANT SALAMANDER OF JAPAN
(*Megalobatrachus maximus*. Schl.)

By Dr. C. Kerbert
Director, Royal Zoological Society, Amsterdam.
(Translation, L'Aquarium de la Societe Royale de Zoologie, Amsterdam)

AS I have already had occasion to publish in the "Zoologischer Anzeiger," Vol. 27, No. 10, 1904, in an article "Upon the propagation of the Giant Salamander of Japan" I have been so fortunate as to witness in the aquarium of our Society the propagation of two giant salamanders. Sasaki, as we know, had seen the singularly formed chain of eggs formed by this Salamander at the very place where it originates, the little rivulets of the mountains Iga and Ise of Japan, says: "All efforts to propagate Cryptobranchus in captivity have failed until the present day; the cause no doubt lies in the difficulty of procuring in a city the cold water to which these animals are accustomed in the mountains." Our society received the two examples in 1893, which were placed in a tank of our Aquarium M.2.11 length, by M.1.92 width and M.1.63 depth, in the effort to try if perhaps it would be possible to propagate these animals under favorable conditions in the fresh water of our Aquarium. I hoped, but I was not sure, that they would prove to be of different sexes. For there is no doubt that the difference between the individual males and females of the giant salamander is not observable excepting during the breeding period, and notably by the fact, observed by me with the greatest certainty, that with the male (August and September) the folds around the vent flutter in a most extraordinary manner, while the female remains normal. At the beginning of August, 1902, the animals were already comporting themselves in a quite unusual manner. While they are generally lazy and stupid, during days and weeks they remained quiet, as still as if dead, in the bottom of the tank, never seizing the fishes held out to them, but moving very slowly from the light and seeking the darkest corners of their tank. They commenced in August to approach and touch one another. Many times tremulus, undulating movements were observed.

The supposition was not far off, that an excitation of the nervous system had commenced as preliminary to propagation. The love play lasted but a few days. On the night of the 18th of September, 1902, for the first time in our Aquarium, the deposition of eggs took place, notably by the smallest—M.0.85—of the two examples. As one may see in the figure, the female has deposited, several times enlaced around a piece of rock work at the bottom of the tank, the eggs strung in long gelatinous cords, resembling a rosary, as Sasaki has already described them.

The size of the egg capsules is about 20 mm., the thickness of the walls of the capsules, 2-2½ mm. The interior (wall) is of strong consis-

tency, tough and surrounded by other teguments, Ishikawa counts 12-15. The exterior tegument is probably formed of the lower part of the oviduct showing clearly a turning in the form of a chalaza and seemed also to be of a passably tenacious consistence.

The eggs are of spheroidal shape with a diameter of 7-5 mm. or 6-4 mm. and are of yellowish color. I estimate the number of egg capsules to be about 500 and more, though I admit that the number and dimensions of these egg capsules may differ according to the dimensions of the animals.

However it may be demonstrated that the emission of eggs in the form of a rosary is not rare among amphibians, nor the rule among Derotremes, I must insist upon the fact that the egg capsules of the Giant Salamander differ from those of allied forms, in that the eggs are always smaller than the volume of the capsules, filled with a liquid and floating in it. While the eggs of *Ichthyophis, Menopoma, Amphiuma* and *Desmognathus* and later also their embryos, occupy the entire space of the capsule.

The eggs emitted in our Aquarium in 1902 were, unhappily, not fecundated. We were more fortunate in those emitted, in September, 1903, about 6 o'clock in the afternoon. In what manner the fecundation of the Megalobatrachus maximus is performed it is impossible for me to state now, the fact is not yet established. I hope that some time I may have the knowledge.

After the emission of the eggs in 1903, the female withdrew herself, evidently in a state of great exhaustion, to a corner of the tank with no idea of care for her eggs. The male on the contrary had not left the nest for a single moment. It is he who constantly "guards the bridge." The nest this time had been deposited in a sandy hole in the tank. The watchfulness of the male was so very faithful that after several days I was obliged to separate the animals, because whenever the female approached the eggs the male dashed at her with fury and chased her away. Under these circumstances it was better to place her in another tank. The male salamander moved among the gelatinous cordons of eggs and laid upon them, in part covered them or placed himself simply beside them. In both cases, from time to time, he moved all the mass of eggs by the oscillating movements of his body. Following these movements he produced a current of water of enough force for the respiration of the eggs and the embryos, while the mass of the eggs at the same time changed continually.

The fact that the male of the giant salamander took care of the nest was unknown until this time. Ishikawa made due mention that these animals took care of their eggs, but he thought that the individual observed among the mass of eggs from the beginning of August to the first of October must be a female. In what manner Ishikawa had proved the sex of the animal which remained with eggs is not clear in his discourse of the 28th of November, 1900, in the Deutsche Gesellschaft für Natur und "Volkerkunde Ostasiens" and printed in the "Mitteilungen" of the said Society. In the new edition of this discussion—after the publication of my observations, accompanied by several illustrations,—Ishikawa making no mention after these observations and these experiences seems to think himself justified in asserting the feminine sex of the animal. After my observations, the female, as I have already said, never thought of guarding the nest, and without any doubt it has been proved, that it is the male alone, who takes care of it.

During the development of the eggs, the capsules visibly enlarge. While the capsules of the eggs of our animal, freshly emitted, had a diameter of about 20 mm. this diameter is already become from 23-24 mm. au stadium. For example the embryo is already 27 mm. and the three pairs of exterior gills and the commencement of the two pairs of extremities are already visibly developed. This enlargement of the capsule and the increase of the liquid it contains, which probably serves as nourishment, may perhaps be attributed to the absorption of water by the walls of the capsules.

Simultaneously with this enlargement of the capsules the Embryo rests upon the exterior walls of the capsule commencing to detach itself little by little; after this one may see them floating upon shreds in their water beds.

The first of the larvae came out November 10, 1903, the greater part, November 26, 1903. The entire development from the deposition of the eggs until the hatching of all the larvae takes from 52-68 days or a little more than eight to ten weeks at a medium temperature of water of 13° C. The length of the larvae when hatched is about 30 mm. The larvae of October 25 already showed the exterior gills and the commencement of the extremities of the anterior gills. The commencement of the posterior extremities is also distinctly developed among those of the 27th of November. The mouth opening now ventrally visible, slowly becomes terminal as in the adult animal. The youngest larvae of the *Megalobatrachus maximus* are not

Fruit-eating bats (*Pteropus*). A protected colony in the village of Hihifa, Tonga Islands, Polynesia.

known at present. The youngest larvae known and described by Sasaki has a length of 19-20 cm. and still show the gills. With one individual 24.5 cm. the gills have already disappeared. The larvae period of the Megalobatrachus maximus seems then to be passably long. At this time 9 larvae from 15-18 cm. in length are developing exceedingly well, with the water at a temperature of 13°-20° C. The other larvae have been sacrificed to research for embryologic details.

THE BITE OF THE VAMPIRE

By C. H. Townsend

A NATURALIST engaged in studying animal life in the tropics, recently made the statement that the blood-sucking bats could not bite a human being without awakening him. There was in his party a man who slept so soundly that it was always difficult to get him up in the morning. He found by experiment that the slightest touch with a needle had the effect of rousing him instantly. Other members of the party reacted similarly.

He also made the statement that in biting animals, the wound made by the vampires does not continue to bleed, the saliva of the bat possibly having some astringent quality. These statements being at variance with my experience in Honduras, I discussed the matter with Mr. Edwin Lefevre, the well-known author, who was born and raised on the Isthmus of Panama, where blood-sucking bats abound. Mr. Lefevre made the following statement:

"In the village of La Chorrera near Panama, in the summer home of a relative of mine, a young girl was nearly killed by a vampire. The mistress of the house slept in a large room which had the latticed shutters of the tropics, beside her bed was a cot on which slept her granddaughter aged four.

Awakened one night by the restlessness of the child, she lit a lamp and was horrified to find her feet bathed in blood and the bedding saturated with it. The household was roused and blood was found flowing from a wound under the base of the great toe. It was realized at once that a vampire had been at work and a search soon revealed the bat. The child suffered from anemia for years, being always pale and delicate.

The same child grown to womanhood, had a maid from Capira who was anemic as the result

A protected colony of fruit-eating bats in Hihifa. By counting the bats on one tree, we estimated that there were 6,000 in the tops of the fifteen trees which they occupied.

of a similar experience, having been bitten twice by vampires. The circular scars of the two bites remained, showing that the flesh had been cleanly bitten out rather than merely punctured.

The dairymen of Panama in pre-canal days kept no cows in barns. Pastured in the daytime they were herded in corrals at night where they were fed. At all such enclosures it was the invariable custom to hang on strong poles several lighted lanterns to keep off the vampires. I have seen as many as fifteen lanterns in use at a single corral to keep the bats away. To say that vampires do not cause serious hemorrhage is pure ignorance. I have known dairymen on the Isthmus to lose many cows from their bites. They told me that the bites inflicted in two successive nights caused such loss of blood that the cows were worthless, one man losing his entire herd which had been left unprotected. I know personally about the mischief of vampires on the Isthmus. Their bites are usually made where the blood will flow freely. In the case of human beings the sleeper is seldom awakened until the mischief is done."

Darwin in the "Voyage of the Beagle," relates the following:

"We were bivouacking late one evening near Coquimbo, in Chile, when my servant, noticing that one of the horses was very restive, went to see what was the matter, and fancying he could distinguish something, suddenly put his hand on the beast's withers, and secured the vampire."

In his "Naturalist in Nicaragua," Belt makes the following record:

"A day or two before we left the mills we had an opportunity of seeing the effects of the vampire's operations on a young horse Mr. Leavens had just purchased. The first morning after its arrival the poor animal presented a most pitiable appearance, large streams of clotted blood running down from several wounds on its back and sides. The appearance was, however, I dare say, worse than the reality, as the bats have the skill to bleed without giving pain, and it is quite possible the horse, like a patient under the influence of chloroform, may have known nothing of the matter. The danger is in the attacks being repeated every night till the loss of blood becomes serious. To prevent this, red peppers are usually rubbed on the parts wounded, and on all likely places; and

this will partly check the sanguinivorous appetite of the bats, but not entirely as in spite of this application the poor animal was again bitten the next night in fresh places."

Bates, in his *Naturalist on the Amazons* in referring to blood-sucking bats, says: "The fact of their sucking the blood of persons sleeping, from wounds which they make in the toes, is now well established."

According to the following he had some personal experience with them. "The next morning I found a wound, evidently caused by a bat, on my hip."

"According to the negroes, the *Phyllostoma* is the only kind which attacks man. Those which I caught crawling over me were Drysopus."

Goldman, author of *Mammals of Panama*, was bitten by a wounded vampire, whose "upper incisers neatly scooped out and completely removed a bit of skin leaving a wound from which the blood flowed freely."

Dr. Hale, in medical charge of a U. S. Government party in Eastern Panama in 1870, says in his report, as quoted by Goldman, "The upper incisors which are chisel-like teeth, are used in making the incisions when blood is drawn."

Beddard, in the *Cambridge Natural History*, tells why these bats must live on blood alone: "In accordance with its diet of blood, the vampire has a peculiarly modified intestine. The gullet is provided with a bore so small that nothing but fluid food could pass down it; the stomach intestiniform in shape."

It is known that the blood-sucking habit in bats is confined to certain small species of the genera Desmodus and Diphylla, and that these are found only in tropical America. I explained to Mr. Lefevre that he was in error in supposing that the large fruit-eating bats of tropical America, belonging to the genus Vampyrus, were also blood-suckers. In this case the name is unfortunate and misleading, as the fruit eaters are harmless.

That the large fruit-eating bats of Polynesia are harmless so far as blood-sucking is concerned, I can testify from my own experience. In 1899 I visited a large colony of fruit-eating bats that occupied a group of trees in the village of Hihifa in the Tonga Islands. The bats had always been under the protection of the village chief and it was with difficulty that I secured permission to kill a few for natural history specimens. There were fifteen large trees in the grove, the tops of which were festooned with bats in a way suggestive of fruit trees. By counting those on one tree we estimated the colony at about six thousand. The bats occupied only the bare tops of the trees from which the leaves had disappeared. There they hung by their feet, head downward, with their broad membranous wings wrapped closely about them. Many of the females held their young concealed under their wings. The bodies of our specimens were as large as those of grey squirrels, the outstretched wings having a spread of about two feet.

The bats hung in the hot sunshine all day long, few taking flight until evening. Although they did considerable damage to the fruit supply of the island the people did not disturb them. Perhaps they had been useful at some time in the past when food was scarce, as fruit bats are used for food in the East Indies. The fact that the bats occupied trees overhanging a part of the village graveyard may have had something to do with their preservation, we got no satisfactory statement however as to either theory. One thing was certain, the bats were "tapu," an interdiction which no Polynesian dares to disregard.

KEELING SICK FISHES

By Albert Eide Parr

IT is well known how a desperately sick fish will often turn helplessly on its back, losing its ability to maintain its normal equilibrium. Popularly this is regarded as a symptom, only, of the weakened state. It is, however, also an added cause for the weakness, perhaps even in itself a fatal danger to the fish.

Through the outraged sense of equilibrium, the general vitality is probably lowered and the damage to the blood-circulation must certainly be of great importance. The circulation is in general more or less dependent upon the regular and unchanging effect of the gravity upon the flow of the blood. Human beings for example would die in a short time if they kept standing on their heads, thus reversing the effect of the gravity in their blood-vessels. In a fish, the axis of the body and the position of the main blood-vessels being horizontal, not vertical, the overturning about the horizontal axis would at first thought seem insufficient to have any great effect upon the circulation. There are, however, smaller but not less important branches of the vascular system to be considered. All internal organs of the fish (not the gills) are supplied with blood from above through arteries branching off from the main dorsal trunk (dorsal aorta), which runs closely below the vertebral

column. In the normal state of equilibrium the flow of blood through these declining arteries to the internal organs is aided by the force of gravity. When the fish is overturned, this aid is not only withdrawn but the same force is now working directly against the flow through the arteries in question. The aid is simultaneously transferred to arteries in other parts, as, for instance, the gills and the brain, which are not prepared for it and do not need it. This, therefore, does not improve the situation, as it is apt only to produce an oversupply and congestion of blood in these organs, such as we have often felt ourselves in the unpleasant rush of blood to our head when we are bending too low. Now we can clearly see how the overturning must in itself be considered a real danger to the fish and not only a symptom of weakness, because we have every reason to believe that all the internal organs, viz., the digestive tract, with all its glands, as liver, spleen, pancreas, and so on, will suffer from a more or less severe loss of blood supply when the fish is overturned.

In the treatment of sick fishes, it is therefore of great importance to observe that the normal state of equilibrium is maintained; and if this is not done in the natural way by the fish itself, it must be achieved by artificial measures.

A method of keeling was successfully applied by the writer to save a lake sturgeon in the New York Aquarium from the effects of suffocation due to the obstructing influence of potassium permanganate upon the mucus of the gill chamber. The specimen was floating at the surface and the respiratory movements completely stopped, thus leaving, to all appearances, a dead fish. After the mucus of the gill chamber had been quickly washed away, a current of fresh water was forced through the gills by putting a hose in the fish's mouth. By some pumping of the heart-region, a natural respiration was then faintly restored. As soon as the fish was left alone again, however, it would turn over and respiration would stop. After having tried this a couple of times with the same result, I finally tied the specimen to a piece of light iron pipe about as long as the fish. With this as a keel, it lay on the bottom in its normal position for about five hours. The respiratory movements gained in strength and the specimen then developed a nearly normal respiration and could keep its balance unaided for a considerable period. As the maintenance of the equilibrium, however, evidently still was an effort, a small coil of metal wire was tied below the body just in front of the pectorals to replace the heavier iron pipe. After thus having had its equilibrium artificially established for twenty-four hours, the specimen was again normal and could be returned for exhibition.

Note: Normal equilibrium has been restored in goldfishes weakened by winter hibernation, by F. V. Gillis of Peking, China, and by Dr. Dida of the Aquarium de Nice. Gillis buoyed the fishes by inserting a bent pin in the dorsal fin, this being tied to a floating bit of wood. Dida used a metal "harness" which allowed the fish to swim about, while preventing it from turning.

Parr, Gillis and Dida are the only people we know of who have ever made these interesting experiments. The keeling method is difficult with soft-scaled fishes. Dida reported that any pressure upon the scales would cause fatal skin trouble. The sturgeon, with its bony scutes, lends itself admirably to such an experiment.

—I. M. M.

TRANSPORTING LIVE FISHES FROM NEW YORK TO SAN FRANCISCO

By Robert J. Lanier
of the Steinhart Aquarium

DURING 1926, I resolved to arrange for two extra weeks' vacation, in order to visit with relatives and friends in my home city, New York, from which I had been absent for four years.

Mr. Seale, Superintendent of the Steinhart Aquarium, thereupon suggested that I take some Hawaiian fishes to the New York Aquarium and bring back specimens from the Atlantic. The plan did not arouse my enthusiasm, but when Director Evermann summoned me to his office to discuss it, I agreed to make the experiment. The New York Aquarium officials felt also that my chances of getting the collection through alive, as well as my chances of getting any sleep on the journey, were extremely small. Director Townsend wrote, "It is a long haul for live fishes without the advantage of a fish car and it would be interesting to see how you make out."

The latter part of August, I left San Francisco, my equipment consisting of one oxygen cylinder type K, containing 220 cubic feet of oxygen, a ten-gallon tin can to serve as a reservoir for my filter, four pieces of muslin 18 x 18 inches medium weight, for filtering the water (filtering the water during transit never having been tried), aerators, rubber tubing, etc.

When all was in readiness, five cans were filled three-fourths full of salt water and placed on our truck. In two cans 20 inches in diameter and 23 inches in height, holding about twenty-

five gallons of water, Hawaiian and Pacific coast fishes were placed, six in one can and seven in the other. In two large oval cans 34 x 24 x 20 inches, holding each about fifty gallons, more Hawaiian fishes were placed, six in one can and five in the other. The remaining can was a low oval 42 x 14 x 13 inches, holding about twenty-five gallons of water. In this, four Leopard sharks and one Singing fish were deposited.

And so my twenty-nine finny friends and I set out from San Francisco for New York, none of them foreseeing the fullness of their martyrdom or that I should be the sole survivor! We all put up a good fight—I for myself and the fishes, they for themselves. The water was aerated by the common method of lifting it out with a quart tin dipper and allowing it to drop slowly back, gathering oxygen as it went. This attention began on the ferryboat to Oakland and did not end until my last specimen died a few miles from the New York Aquarium.

The baggage cars, crowded with mail pouches and baggage, left little room to work around fish cans, and I was obliged to do considerable climbing and to work under difficulties. Yet I managed to place my oxygen cylinder upright against the wall of the car, hold it in place with the cans, connect to the cylinder my pressure gauge and manifold, which had six hose connections, and to get one hose in each can, thus supplying oxygen to the fishes.

The first horrifying discovery was at Port Costa, thirty miles from San Francisco, when it developed that the liberators were not working properly, sending off large bubbles of oxygen instead of a fine spray. All the liberators but one were in a very bad state of corrosion between the metal collar and the porous stone, allowing large quantities of oxygen to escape, instead of forcing it through the stone. These liberators had been used before, and Mr. Adams, Assistant Superintendent of the Steinhart Aquarium, had selected them especially for me, as we were both confident that they would work better than bass wood or rattan.

When I began to remove the old stone liberators—horror number two—the bass liberators I had taken along could not be found. This meant that my specimens would all die unless I could make some substitute liberators. The engineer of the boat responded to my appeal by supplying a block of white pine. This could be cut into small round pieces to fit into the ends of the hose; but—horror number three—I had left my knife in my working clothes at the Aquarium! In vain I tried to buy one. But again there was a friend in need. Mr. Tose, taxidermist for the California Academy of Sciences, who was going east to visit museums, kindly loaned me a knife and scalpel. Six wood liberators were soon made and installed, and my fishes were made more comfortable by the fine spray of oxygen they now received.

The first to go was the singing fish (*Porichthys notatus*), 147 miles from Frisco, having survived but eight hours.

The slime from the fishes, and the coal dust, accumulated so fast on my muslin filter as to clog it and to call for clean muslin every twenty-five minutes. With five cans to filter, this meant washing the muslin from fourteen to sixteen times every twenty-four hours.

At Echo, Utah, 550 miles from Frisco, one surgeon fish (*Hepatus olivaceus*) passed out. It was a beautiful creature, with an oval orange spot on each side, its whole body a rich olive brown, with a narrow orange line running the entire length of the base of the dorsal fin.

At Evanston, Wyoming, 759 miles from Frisco, one of my butterfly fishes (*Forcipiger longirostrus*) died. It is an odd species, with a long, forceps-like mouth.

One common southern California food species, much in favor for fish chowders, is the sheepshead or redfish. One of these went next, and two others, besides a black-finned triggerfish (*Melichthys radula*), a uniformly black fish with a conspicuous narrow line of bright blue running longitudinally along the bases of both dorsal and anal fins, making a striking picture. The death of this fish, which belongs to a hardy species that generally withstands transporting well, was discouraging.

By the time we reached Grove, Illinois, six more specimens were gone, besides a Garibaldi (*Hypsypops rubicundus*) commonly known as the salt water goldfish and a familiar sight to those who look through the glass-bottom boats about Santa Catalina Island. The temperature of the water, which was 74° on leaving Frisco, had descended to 65°. Thus I arrived in Chicago, 2261 miles from the Pacific, minus fourteen specimens and with fifteen living fishes, representing nine species, which had been on the road under such extremely trying conditions for seventy-two hours. Whether they were as tired as I was, it would be hard to tell. How I did wish I might stop over in Chicago for a rest! I had had but eleven hours' sleep. If only the small Chicago Aquarium were supplied with salt water, permitting my resting the precious fifteen for two days, I know they would all have reached New York alive. It was Labor Day,

the stores were closed, and I could not get anything suitable for a filter, which was badly needed.

It was hard, two hours out from Chicago, to see one of the beautiful Moorish idols (*Zanclus canescens*) stop breathing, and to lose a pink-tailed triggerfish (*Balistes vidua*) at Fort Wayne, Indiana. These triggers are not used for food, being reputed to be quite poisonous. Passing through Ohio, I lost five more, besides a fish (*Stephanolpis spilosomus*) so rare about Honolulu that its appearance is believed by the natives to foretell the demise of some great personage such as a king or chief.

At Pittsburgh, 2729 miles from the starting point, one more Garibaldi, one more pink-tailed triggerfish, and one leopard shark (*Triakis semifasciatum*) were lost. The Leopard sharks are common on the California coast, small sharks reaching a length of but three feet. Another Garibaldi and two more Leopard sharks, having traveled for ninety hours and covered 2837 miles, died soon after leaving Pittsburgh. The last fish, a Leopard shark, was dying when we reached the Pennsylvania Station, New York City, and I arrived at the Aquarium with only two dozen large crawfishes packed in moss and excelsior. My fishes had all died of slow suffocation. The salt water in each can when I reached New York looked like lemonade with pulp floating in it, so much slime had the fishes given off, and so much coal dust and other foreign matter had there been picked up from the road bed; and I resolved at any cost to get a proper filter before starting back with the return shipment.

After traveling from one end of Manhattan Island to the other, I finally found the Carey Chemical Company in Greenwich Street, dealers in malt, syrups, cordials—and felt filters good for home brew outfits and guaranteed to wash perfectly by rinsing in fresh water. For this treasure they asked one dollar and fifty cents. The filter is cone shaped, 12 inches in diameter, 15 inches long, and about 3/16 of an inch in thickness. Four brass eyelets arranged equidistant around the rim enabled me to fasten it with short pieces of wire to the top of my ten-gallon tin can. Having spent my entire vacation making preparations for the return trip, purchasing toy tropicals in Philadelphia and elsewhere, and scarcely seeing my family and friends, I finally left New York with four large cans of salt water specimens and four cans of freshwater specimens.

There were four spot snappers and two red-winged sea robins in one twenty-five gallon can, five pork fishes and one black angel in another. In one fifty-gallon can were three red groupers and two blue angels. In another, two rock hinds, two red hinds, and two Queen triggerfishes. Into the fifth went some fresh-water specimens—four yellow perch, two pikes about 14 inches long, and six pearl roach.

In a three-gallon can were twenty-four European bitterlings, in a one-gallon can were four *Acara*, two mouth-breeders, four black-nosed dace, and two prize-winning golden platy. In a three-quart can were a pair of red helleri hybrids, a gift to the Steinhart Aquarium from Mr. Henry Kissel of Cliffside, New Jersey, the specimens having won first prize for red helleri hybrids at the Hudson County Aquarium Society's exhibition of 1926. The golden platy were also presented by Mr. Kissel.

On the way from the New York Aquarium to the Pennsylvania Station—horror number one—the red groupers vomited, evidently having been fed the day previously. Fishes should not be fed for several days prior to a journey, as they are subject to car sickness and sea sickness. I threw away half of the salt water from that can. Then—horror number two—I discovered that my suitcase had been left at the New York Aquarium and telephoned to have it sent to the station. My hope was to receive it at Chicago.

As we were speeding through the tunnel under the North River, filtering began in the red grouper can. It took three hours to get the water clear and then I added water from the four other cans, which left just about enough to carry the fishes comfortably but with not a drop to spare. My home brew filter had already proved its efficacy and my only worry now was that the temperature might drop.

At Philadelphia, Mr. J. Louis Troemner, President of the Pennsylvania Fish Culturists' Society, met me at the train with a can of fresh-water tropicals. From then on to Oakland, I filtered the water from five to seven times each day. Each filtering took two hours and thirty-five minutes, including time spent washing the filter twice after each time it was used.

The only specimens lost before reaching Chicago were a pike that had been wounded ere leaving the New York Aquarium, but whose injury had evidently escaped notice when it was taken from the tank there, and one yellow perch. Mr. Walter H. Chute, Associate Director of the proposed Shedd Aquarium, met me at Chicago and cared for my charges while I hunted up the baggage master to inquire about my suitcase. It had not been seen. Now I was

in a sorry plight. No clean linen, razor, tooth paste or other essentials toward keeping a man from looking like a tramp. By good luck, however, everything needed could be purchased in the station, excepting a razor. Was I destined to arrive in Frisco with a week's beard? As the train pulled out, and Mr. Chute bade me good-bye, I began to filter the water again. After a time my prospects brightened. We stopped at a small town for ten minutes, and the baggage man kindly held the train while I visited a hardware store and purchased the coveted razor.

The porter in the wash room assured me that I would not be allowed to make use of that room without a Pullman ticket—taking it for granted that such a dirty man could not afford a ticket! He was soon convinced, however, and with clean shave and clean linen, I made my way to the dining car.

At Tama, Iowa, a spot snapper jumped out of the can and was hurt, and two yellow perch were so weak that all three were taken out at Omaha, Nebraska. We had now covered 1403 miles and one blue angel was acting queerly. The water in its can was dashed about so violently with the movement of the train over an uneven roadbed as finally to kill it. On the trip east, a fish had been thrown out of the can along with a bucket of water, by reason of the train's high speed over just such a rough roadbed.

Through the courtesy of the baggage man, the steam heat was turned on in the baggage car and we moved the cans around the radiator, thus raising the temperature in them from 64° to 70°. The specimens responded immediately by increased activity.

One spot snapper succumbed at Laramie, Wyoming, and one bitterling died at Ogden, Utah, when we had covered 2390 miles and my sleeping hours had numbered not more than four at any one time. Mr. Richard Dorn, President of The Aquarium Society of New York, had given me six terra cotta liberators and two needle valves, which worked to perfection and were used in three of the cans. In the can containing the bitterlings, for example, I had one terra cotta liberator and allowed the oxygen to be liberated at the rate of about four small bubbles a second. This was maintained constantly throughout the trip.

Things were going so promisingly that as we passed over the Great Salt Lake, I sat in the dining car and dared to enjoy the scenery and take a little much needed rest and a brief respite from worry.

The pikes and pearl roach had a treat at Cobre, Nevada, where they received some fresh water. The steam could now be omitted, as the water was 73° and the air warm. The filtering continued steadily. The baggage man was anxious to take part in this, and I was only too glad of relief, having lifted up to this time approximately 12,850 pounds of water to a height of three and a half feet.

I arrived at the Steinhart Aquarium after four days on the road, the water in my tanks free from slime and dirt, and having covered a distance of over 3169 miles, with but nine fishes lost. The specimens carried safely across the continent were twenty salt water fishes, eight large and thirty-seven small fresh-water fishes, besides three king crabs and one lobster.

The secrets of success were the home brew filter, the maintenance of a temperature of 72°, and of course the constant supply of oxygen to the specimens. Such a trip could be made easier by using an electric motor to circulate the water in place of a quart dipper. This would also eliminate the danger of striking the fishes with the dipper when lifting water from the can to the filter.

CURING THE PENGUIN OF BRONCHITIS

By Ida M. Mellen

EVERY Galapagos penguin we have had at the Aquarium has died of bronchitis, excepting the present "Charlie,"—they are always called Charlie because of their Chaplin-like walk.

When Dr. Noback was at the Aquarium to advise with the writer upon another matter early in December, 1926, our fish culturist, Mr. Howley, suggested that he be asked to take a look at Charlie, who had developed the typical bronchial cough, listlessness, and loss of appetite. Dr. Noback saw the bird and recommended inhalations of hot benzoin, and, at my discretion, a little cough medicine.

Beginning the following day, the penguin was given benzoin treatments, usually twice a day, receiving in all twenty-three inhalations. As his throat was sore and swallowing difficult, he was given Brown Mixture cough medicine, until he could swallow without difficulty, receiving all together nine teaspoons of this remedy. After the very first dose, three killifishes slipped down his throat quite easily. His appetite was soon restored and at the end of nineteen days he had stopped coughing and could take thirty killies at a meal (his normal number being

about fifty) and the treatments were no longer necessary. They were discontinued on December 27. The bird, which weighed seven pounds in October, 1926, had lost three pounds. By January 10, he weighed four and three-quarter pounds. By January 26, he weighed five and one-half pounds. By February 15, six pounds. By March 17, six and one-quarter pounds.

The water around the Galapagos Islands is cool, but the air is blistering hot. When the penguin got bronchitis, he was afraid to go into the cold water in the pool, and as, on being returned to the pool, he had a chill immediately after the first treatment, he was removed to a large, glass-sided tank near a radiator, with a platform leading out of the water. It was decided that as he could not have warm air, he must have warm water, and therefore the water in this tank was warmed to 80°. This was a most welcome treat to the bird, and with manifest delight, he jumped in and took a bath—the first in over two months. It was the splashiest kind of a bath, and did him a world of good. In order to insure his being kept dry at night, a cage was placed in the lower office, to which he was transferred every day at closing time. In the morning, he was taken upstairs to the library for his treatment, and again in the afternoon. The benzoin fumes were administered through a wire hatching tray on which the bird stood under a fibre waste basket.

People often ask if he grew to know me. He did. One morning when taken upstairs prior to my arrival the penguin was standing on the threshold of the door between the director's office and mine when he spied me. He pattered over, cast an eye up at me, and then ran on to the door of the library, where he was accustomed to take his treatment! This was the more surprising because the penguin is not a demontrative bird, like a parrot or a siskin.

An artificial penguin was given me about this time, and when our bird saw it, he ran up and grasped its yellow felt beak in the friendliest manner; but on discovering that the bird was a counterfeit, he hurried away. The next time he encountered the cloth penguin, he ran up to it and tweaked its beak angrily, as though to say "You fraud!" and never would go near it again.

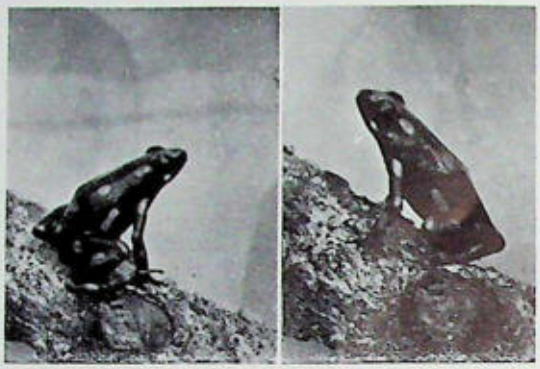
The penguin is always ready with his beak and although his keeper James Savage, is one of his chief admirers and takes him out for a walk on the floor every morning, the bird's bites leave marks on the man's hands. During all the treatments, he bit me only once, and then succeeded only in ripping the finger off a rubber glove. It is well for the bird, Savage thinks, that he does bite, for his charm is such that he invites to fondling. After the closing hour he follows the director entirely around the main floor and balcony during the evening inspection of the tanks, and on one occasion, after his health was restored, he hopped up the fifty-two stairs to the top floor. When touched on the tail during this ascent, he interpreted it to mean that he was being urged to hurry, and growled like a dog.

NESTS OF SOME TROPICAL FROGS

By C. M. Breder, Jr.

IT is commonplace knowledge that all frogs of the eastern United States are peculiarly lacking in striking specializations of their breeding habits. Of course each species differs slightly from the others in details of the habits of reproduction but all agree in resorting to some body of water for the purpose of depositing their eggs free in the water. All the way from the common and often exceedingly abundant bull frog or "jug-o-rum," valued for its succulent hind limbs, to the comparatively little known and very local Anderson's tree frog of very different relationship, this general method of egg laying is to be found. By those of us not familiar with the frogs of other climes it might very easily be assumed that the breeding habits of frogs are pretty much the same the world over or possibly a few noteworthy exceptions may be known of. Some of these have been somewhat popularized by the old line natural histories such as the midwife toad of Europe in which the eggs are entwined about the hind legs of the male, who stays with them in this position through incubation, or the Surinam toad of South America that carries its young in individual pouches on the back until they are ready to leave as miniature replicas of the parents. These might be considered, in the absence of other knowledge, as stark exceptions to the generality of frogs. However, such is not the case and the number and variety of specializations looking toward the welfare of the offspring is legion. It may be of interest, therefore, to consider some of these in more or less detail.

Just as our local region is particularly uniform as regards such habits in frogs, so Central America is particularly diversified. We may confine ourselves therefore to a few instances that have come under my personal observation there, during the year of 1924, when I was in remote regions of Panama in the interest of the American Museum of Natural History.



Two poses of the poison toad (*Dendrobates tinctorius*)

The much written of poison toad *Dendrobates tinctorius*, is one of these, which incidentally is not a toad at all but more nearly related to the tree frogs, although quite terrestrial in habit. This is the frog that is supposed to be used to supply the poison for native blow-gun darts in northern South and Central America. It is a little fellow not more than an inch and a quarter long of a beautiful soft velvety black covered with a profusion of bright green spots. It is active and diurnal in habit and spends much of its time hopping about in search of food on the rich carpet of the tropical forest. Its breeding habits are not known in full detail but at the proper time of year the females may be found hopping about the jungle with very ordinary looking little black tadpoles clinging to their backs. Those which I saw never had more than two and frequently only one, all of which were arranged heading forward.

Probably the most spectacular specializations of this region are concerned with actual nest building or possibly more properly with nursery building about which we are chiefly concerned here. One of the most striking of these is constructed by a huge frog superficially somewhat resembling our bull frog in size and general outline *Leptodactylu pentadactylus*. It is a rather handsome brute of an olive green tint set off by a pinkish flush on the inner thighs. A full grown one is a veritable bombshell of energy requiring more than ordinary force to hold in the hand. As the very arid dry-season of the Pacific slope of Eastern Panama nears its close the deep throated voice of the males may be heard rumbling up and down the often perfectly dry "cabradows" or creeks of the virgin Darien jungle. It gives a sudden solitary staccato cry of short duration. "Whoop!" it cries, repeating this several times with intervals of some length between each exclamation. Then it rests for a longer period after several such shouts have been sent out on the inky night air beneath the densely tangled low growths of the primeval jungle. Contrary to most enamored frogs this one is exceedingly shy and only on one occasion have I had the pleasure of actually seeing one call in the full glare of my flashlight. Generally long before a close approach could be made they became silenced and retreated to some ready shelter. This species does not appear to congregate in great numbers for spawning purposes as do so many species but remains scattered about. Indeed, I have never seen or heard two calling when less than one hundred feet from each other. Then, too, they generally call from partly concealed localities, such as the entrances to rock crevices in which they find a safe retreat. When stationed in certain ways the sonorous voice is often magnified out of all proportion and is given a certain amount of directional effect, so that when coming on one suddenly while exploring the nocturnal eeriness of such localities the effect is more than ordinarily startling. At other times they may be easily heard over half a mile away on a still night.

When eventually a suitable mate is found they both repair to a convenient depression in the forest floor, which may be practically dry and far from any standing water of any size or may be close to some remnant of a wet season stream. Here the eggs are laid which do not look so very different at first from those of our home species but as they are extruded, the male at least, and

The froth nests of the large Central American frog (*Leptodactylus pentadactylus*). This mass of foam is over a foot in diameter.

The lagoon-building tree frog (*Hyla rosenbergi*) by day. Note the tight contraction of the pupil.

possibly the female also, engages in such violent kicking with the strong hind legs that the transparent jelly surrounding the eggs proper is beaten up into froth that looks very much like the white of egg after a mechanical egg beater has been brought to bear on it. The eggs are then left to shift for themselves imbedded in an unbelievably huge mass of foam. Several of these masses which I collected intact each filled an ordinary galvanized iron bucket to within seven-eighths of the top. This volume is of course many times the combined bulk of the producers. As these masses lay on the floor of the forest under the dessicating influence of the arid air the outer layer hardens in drying and forms a comparatively impervious crust in which all manner of twigs, leaves and luckless insects are to be found imbedded. Within the protection of this shell the eggs develop and hatch into extremely slim tadpoles. The tadpoles in their early attempts to move about break down the soft froth of the interior mass so that the bubbles burst and the substance liquifies. This gives them a smooth slimy medium in which to swim about. Here they are held prisoners comparatively safe from the outside world so far as dessication is concerned at least. Once, however, I took a small brightly colored snake which, I knew from previous experience to feed on frogs, that had its head thrust through the outer covering and was weaving it about inside and very likely feeding on the unfortunate inmates. Nevertheless, barring such an event or the chance footfall of a tapir or a drove of peccaries, the tadpoles languish in their cell until the end of the dry season. With the first rain, which always comes suddenly here and is of a torrential nature, the "shell" ruptures and nurseries, contents and all are washed down into the rapidly filling stream below where the tadpoles have to adapt themselves to a more adventuresome life and eventually grow up to full frog-hood and become ready to repeat the cycle.

To me one of the most fascinating frog life histories that I have had the opportunity of studying in detail is that of a comparatively great tree frog *Hyla rosenbergi*. It averages about three inches in length and is a soft pleasing shade of brown. During the latter part of the dry season the males descend to the stagnant remnants of some jungle creek and select sandy bars adjacent to some bit of water. They then take up a position just about at the water's edge and pivot around on their haunches slowly digging a shallow hole of a diameter somewhat more than twice the length of their body. With their front feet they tamp the loose sand into a circular dike so that a dish-shaped depression about ten inches in diameter results which is filled by seepage to a depth of an inch or so. In this little lagoon the male then sits and calls persistently for a mate. This calling may go on for several nights, the males retreating to the fastnesses of the tree tops to spend the days.

A newly-constructed nest of the lagoon-building frog compared with a two-foot rule.

A male calling from his recently constructed lagoon, by flash-light. Note the distension of the vocal pouch. The call of this species is three rapidly repeated sounds very similar to knuckle-rapping on a thin resonant board.

The ready-made lagoon on a rocky shore. Here a dam was merely thrown across the mouth of a tiny inlet. Note the abundant black eggs. These hatched a few days later into a seething mass of tiny tadpoles.

After the nest has once been made the males may be often heard calling anxiously about sundown as they are descending from their tree-top day beds before actually entering their nests. Finally a mate is located and induced to enter the nest and a single layer of floating eggs which nearly fills the dish is left to shift as best it may. The protection this nest offers is from aquatic organisms in the main part of the pool which are highly concentrated at this time of year on account of the shrinkage of the water. Here at the shore line these little aquaria, peopled by hundreds of tiny tadpoles, rest until the walls are destroyed by the filling of the

The jungle from aloft, photographed by U. S. Army Air Service, made in connection with the Marsh Darien Expedition of 1924. Near the center may be seen the mouth of a small creek. It was far up such as these under the heavy blanket of the jungle that the present observations were made. Note the Indian village on the right bank. The large whitish trees are known as "Quipo" and are of an inferior grade of wood. They tower up through the "roof" of the jungle, standing higher than most other growths. The darkish areas are caused by shadows from passing clouds.

stream as the rains of the convulsive seasonal change commence. Sometimes these frogs seem to deliberately take advantage of natural conditions as in the case of one that built a dam across the mouth of a tiny inlet on a rocky shore. To assume that this was actually done intelligently is no doubt too anthropomorphic to be tenable but it is nevertheless fascinating to contemplate. What probably did happen was that the frog tried to build a typical sand nest on the rocky surface at this point and simply succeeded in throwing up such detritus as was in the rock crevice at the lowest point, across the mouth of the little bay.

Many other cases might be cited at considerable length both from personal contact and from the findings of others in regions with which I am not personally familiar, but it may suffice to state that there are many other specializations still different and equally fascinating and many more that none of us know about as yet except from slight, unenlightening but curiosity provoking observations from time to time. Some of these I hope to use sometime as an excuse for further travels in little known regions.

This brief account will demonstrate that there is nothing especially standard about the breeding habits of our local species of frogs. In fact, there is but one species that I have had personal experience with in the tropics that lays free eggs in pools similar to our local forms. This is the so-called giant marine toad *Bufo marinus* which in appearance and habit is almost an oversized form of our common garden toad. While very likely the laying of free eggs in pools is a primitive condition with frogs, wherever conditions have been strenuous enough to require great specialization the frogs have been able to meet the conditions and thrive under what would have been sure death to those more familiar species about home.

A SECOND WHALE SHARK, *RHINEODON TYPUS*, IMPALED ON THE BOW OF A STEAMSHIP

By E. W. Gudger

Bibliographer and Associate in Ichthyology, American Museum of Natural History, New York City

IN 1923, I put on record[1] the capture of a whale shark which had been speared, so to speak, on the bow of a 17,000 ton steamship. This capture was made on May 19, 1923, northeast of the Abrolhos Light on the coast of Brazil in Lat. 17° 57′ S. and Long. 38° 41′ W. The shark in attempting to cross the bow of the vessel was struck by her stem, and was so perfectly balanced that it hung across the bow for some hours and resisted all efforts to hoist it on deck. Finally, in order to release it, it was necessary to stop and back the vessel. My short article was illustrated by a figure made from a photograph taken at the time.

In October, 1926, Mr. R. J. Daniel of the Department of Oceanography of the University of Liverpool sent me photographs showing a whale shark impaled on the bow of a steamship off the west coast of Africa. Later, Mr. Daniel obtained and forwarded to me data giving the time and the location of the occurrence, and Captain Johnson Hughes, commander of the vessel, supplied other data. From these the following account has been written.

This specimen of the whale shark was impaled on the stem of Elder, Dempster & Company's motor vessel *Aba* on the west African coast run. The fish was first noticed at 9:30 a.m. on July 6, 1924, and like the Brazilian specimen, was evidently well balanced, and strongly resisted all efforts to dislodge it. At any rate, the ship's log records that at 15 minutes past noon the order was given to "stand by below." At 25 minutes the log reads "Stopped. Fish cleared from stem," and at 29 minutes past noon, "Full ahead" indicates that the vessel resumed her course.

At noon the position of the *Aba* was Lat. 4° 28′ N., Long. 6° 24′ W. This would be on the Ivory Coast of the Gulf of Guinea, about 60 to 75 miles south of the mouth of the Sassandra River. This is a new location for the whale shark, which, although it was first found in Table Bay, Cape of Good Hope, by Dr. Andrew Smith[2] in April, 1828, has never been recorded from the eastern side of the Atlantic. To this statement, however, there is one possible exception. George Bennett[3] in 1831 saw in Lat. 44° 55′ N. and Long. 25° 10′ W. (near the Azores) two large sharks which one of the sailors called "bone-sharks." This man had been a whaler and said that he had seen these bone sharks close at hand, and that "they are spotted over the back." Bennett's two speci-

[1] Gudger, E. W. An Extraordinary Capture of the Giant Shark, *Rhinodon typus*. Natural History, 1923, vol. 23, 62-63, fig.

[2] Smith, Andrew. Contributions to the Natural History of South Africa. Zoological Journal, 1829, no. 16, pp. 443-444. ———Pisces, in Illustrations of the Zoology of South Africa, plate 26, and description.

[3] Bennett, George. Wanderings in New South Wales, Batavia, Pedir Coast, Singapore and China. London, 1834, vol. II, p. 267.

A whale shark impaled on the stem of the Elder Demster motor vessel *Aba* in the Gulf of Guinea
From a photograph supplied by Captain Johnson Hughes.

mens were too far away for him to ascertain the color, and hence we are left in doubt as to whether they were whale sharks or specimens of the basking shark *Cetorhinus* (*Selache*) *maximus*. The branchial sieve apparatus of these two sharks is very similar, and each might equally logically be called "bone shark."

Captain Hughes wrote that the fish was a shark 25 to 30 feet long and was covered with large white spots 2 or 3 inches in diameter. This description was enought to identify it as a whale shark, but in addition he very kindly sent me three photographs of the fish hanging on the stem of the ship, and these leave no doubt as to its identity.[4]

Here then we have in the eastern equatorial Atlantic a new faunal record for the greatest of sharks, and in its peculiar capture a confirmation of that reported four years ago for another whale shark in the western equatorial Atlantic—on the coast of Brazil (likewise in a region from which the fish had never been reported before). And finally, attention may be called to the remarkable coincidence in the manner of capture of the two great fish—each having been impaled on the bow of a steamship going ahead at full speed.

[4] Mr. Daniels sent me some small photographs but these were mislaid. He then suggested that I write Captain Hughes, who supplied the larger photographs herein used.

A BOOK ON THE SKATE

By Ida M. Mellen

THE Skate (*Raja erinacea*, Mitchell) is the subject of a laboratory manual by Prof. Charles W. Creaser of the College of the City of Detroit; a little book of fifty-two pages, just off the Macmillan press. This classroom manual for the dissection and study of the skate will prove of value to both student and instructor, covering every detail of procedure with the animal to be dissected.

Zoologically, sharks, skates and rays are grouped under the heading of elasmobranchs—fishes with lamelliform gills, a cartilaginous skeleton, mouth on the under surface of the head, and a spinal column that runs into the upper lobe of the tail, producing what is called a heterocercal tail.

The "Little Skate" (*Raja erinacea*) is a good representative of the group, and as it is inexpensive and its maximum length but twenty inches, each student may be provided with a specimen to work with.

The book gives a key to our Atlantic coast skates and rays. The external structure of the skate, its digestive tract, respiratory, circulatory, reproductive, glandular, nervous, muscular and skeletal systems are covered in detail, and a

student who works with this little book as a guide, may expect to lay a substantial foundation in the anatomy and physiology of the lower vertebrates.

A new, cloth-bound, enlarged edition of Fishes in the Home, by Ida M. Mellen, was published in March by Dodd, Mead & Co. It is sold at the Aquarium and in all book stores and many pet shops, and is the last word on the subject.

ITEMS OF INTEREST

Coaxing frogs and crocodiles to eat: James Savage, keeper of animals in floor pools and aquaria, saved a large Florida crocodile from starving when it went on hunger strike during the winter. He found that by angering the animal, he could induce it to swallow dead mackerel. His method was to introduce a long pole into the pool and tickle the crocodile briskly under the chin with it. The animal would soon become sufficiently enraged to open its jaws, whereupon Savage, at the crucial moment and with great dexterity, would fling four or five mackerel in succession into the angry jaws, which instantly closed upon the supposed enemy—and unwittingly swallowed a good meal. As Savage dryly explained it, "He thinks he's got hold of me!" The crocodile regained its appetite and eats amazingly well.

A new method of feeding frogs and toads was introduced by Miss Mellen. It was devised by some Newark friends of hers for keeping a tree toad alive over the winter—a feat rarely accomplished—and consists in the simple method of pressing a bit of raw beef around the end of a thread or string and swinging it before the animal. The morsel is greedily gobbled, and frogs and toads become so fond of this kind of food that when fly season comes again, they actually refuse the flies in favor of the beef!

—I. M. M.

Spider catches fishes: The following is from a letter from Mr. Wallace Adams of the Steinhart Aquarium in San Francisco:

A year or more ago we had a number of the Pigmy Sunfish in one of the balanced aquariums in our swamp room. The specimens kept disappearing in a most unaccountable manner until one morning I found the remains of two in the fold of an overhanging leaf in which a spider had made a nest. Unfortunately, I was unable to capture the spider for identification but at least the fish stopped disappearing as soon as the overhanging leaf was removed.

A Book on The Public Aquarium.—The director of the Aquarium has prepared for early publication by the Zoological Society a thick pamphlet entitled *The Public Aquarium, Its Construction, Equipment and Management.*

Much of this document relates to the mechanics of aquarium management—the invisible but vital side of the institution, that makes possible the keeping of its living exhibits.

The visitor passing along the lines of glass-fronted tanks sees only the interior of each waterfilled compartment. He is seldom aware that water is flowing in all tanks, that there are pumps to keep it flowing, filters to keep it pure, heaters to keep it warm in winter and refrigerators to keep it cool in summer. He is not aware that pumps run day and night, that part of the crew serves in eight-hour watches and that work goes on at midnight as at noon. He does not realize that foods have to be prepared for hungry mouths of many sizes, that temperatures are recorded every hour and that the flow of water is watched constantly.

Many cities in the United States want to build aquariums, but city officials making inquiry on the subject, seldom realize that an aquarium requires a complicated mechanical equipment and is a rather expensive institution to maintain. The constant inquiries by departments of parks in many cities, have made desirable the preparation of this document. It is believed that its publication will relieve the New York Aquarium of much laborious correspondence relative to the subject, and render a real service to persons contemplating the building of a public aquarium.

The writer has not only had experience with the aquarium in New York, but has assisted in the planning of other aquariums in this country. In this paper the writer considers also the treatment of the living exhibits of an aquarium and how they are obtained and safely transported.

It is an interesting fact that, although there are many aquariums in Europe, there is no publication so far as we are aware, in any language, that deals with the creation of such an institution.—M. G.

Shell Molt in the Spiny Lobster: A few years ago the late Professor Verrill of Yale University and I were standing in front of a tank in the New York Aquarium, looking at some large spiny or Bermuda lobsters (*Panulirus argus*). One of them near the front of the tank, suddenly made a few spasmodic movements when a transverse opening appeared behind the carapace. A few quick movements served to

The proposed new aquarium for St. Louis.
From the architect's drawing.

widen the opening and the soft lobster began to emerge from the old shell. The efforts to free itself which followed lasted only a few seconds when the animal was entirely clear. It had literally backed out of the hard shell through the single opening, first apparently getting half clear of the carapace, after which withdrawal from the after part of the shell quickly followed. I made no notes at the time but the entire operation of molting did not, I think, last more than a minute. Neither Professor Verrill nor I had ever witnessed the process of molting, and were amazed at the quickness and completeness with which it had been accomplished.

A lifelong student of the crustaceans, Professor Verrill declared it the most interesting performance of an invertebrate animal he had been privileged to see. We fished out the empty shell which was complete except for the break behind the carapace. I had imagined the molting process to be a gradual working out of the soft lobster from the hard shell, the animal withdrawing its many-pointed legs with difficulty, perhaps like the extracting of one's fingers from a tightly fitting glove.

Professor Verrill wrote later that the very able performance of the lobster was a sight worth coming to New York to see.—*C. H. T.*

The Nice Aquarium.—L' Aquarium de Nice is a beautiful, oblong structure, erected in 1921 on the Promenade des Anglais, which is on the beach at Nice. It is owned and actively managed by M. Dida and contains twenty-five exhibition tanks and a few balanced aquaria. Both fresh and salt water specimens are exhibited, including invertebrates, reptiles and amphibians, and about eighty varieties of fishes. There are 40,000 visitors a year. An entrance fee is charged, as in all other European aquariums. The building is of wood, standing on iron piles which are washed by the surf. Salt water is pumped from the sea three times a day to a concrete reservoir on the roof and there is another large reservoir under the building. Water can be pumped from reservoir or sea, according to conditions.

The tanks are lighted by direct sun through skylights. There are no windows. The exterior walls are paneled and these panels adorned with paintings of aquatic scenes, said to be extremely well done.—*I. M. M.*

A Local Research Station: There has recently been established, in the most attractive part of northern New Jersey readily accessible from New York City, a private zoological station for the field study of such animals as are native there. The station is known as "The Wyanokie Zoological Station." It contains ten acres of woodland and is adjacent to several square miles of available public preserve. This property is owned by Mr. J. E. Brooks of Glen Ridge, New Jersey, who has placed the administration in the hands of Mrs. R. B. Breder. The founder, Mr. Brooks, and the director, Mrs. Breder, have established an advisory committee representing varied scientific interests of which the writer is a member. Associated with him are B. S. Bowdish, Secretary of the N. J. Audubon Society; Dr. Headle of Rutgers College and Chief of the N. J. Mosquito Commission; J. T. Nichols and H. C. Raven of the American Museum of Natural History and Mr. W. G. Taylor, out-doors-man.

Definite research problems under way at the present time are as follows:

Bird banding in collaboration with the U. S. Biological Survey .....B. S. Bowdish
Experimental forest planting .....E. B. Moore
Genetics of certain warblers.....T. D. Carter
Life histories of certain salamanders and frogs
R. B. Breder
Homing instincts in frogs and turtles
C. M. and R. B. Breder
Life histories of certain creek fishes ...C. M. Breder

It is expected that before the summer is over other problems will be taken up by other students including habit studies of certain rodents, experimental methods in mosquito control, studies in mycology, and in arachnology.

The station is well equipped for accommodating workers with comfortable living quarters and has a small amount of working equip-

Aquarium at Nice: The entrance to gallery 15.

ment. There are two buildings, a small stone residence for the director and a large frame building containing ample dormitory space, a laboratory room, a general hall, a kitchen. A dock room is to be constructed.

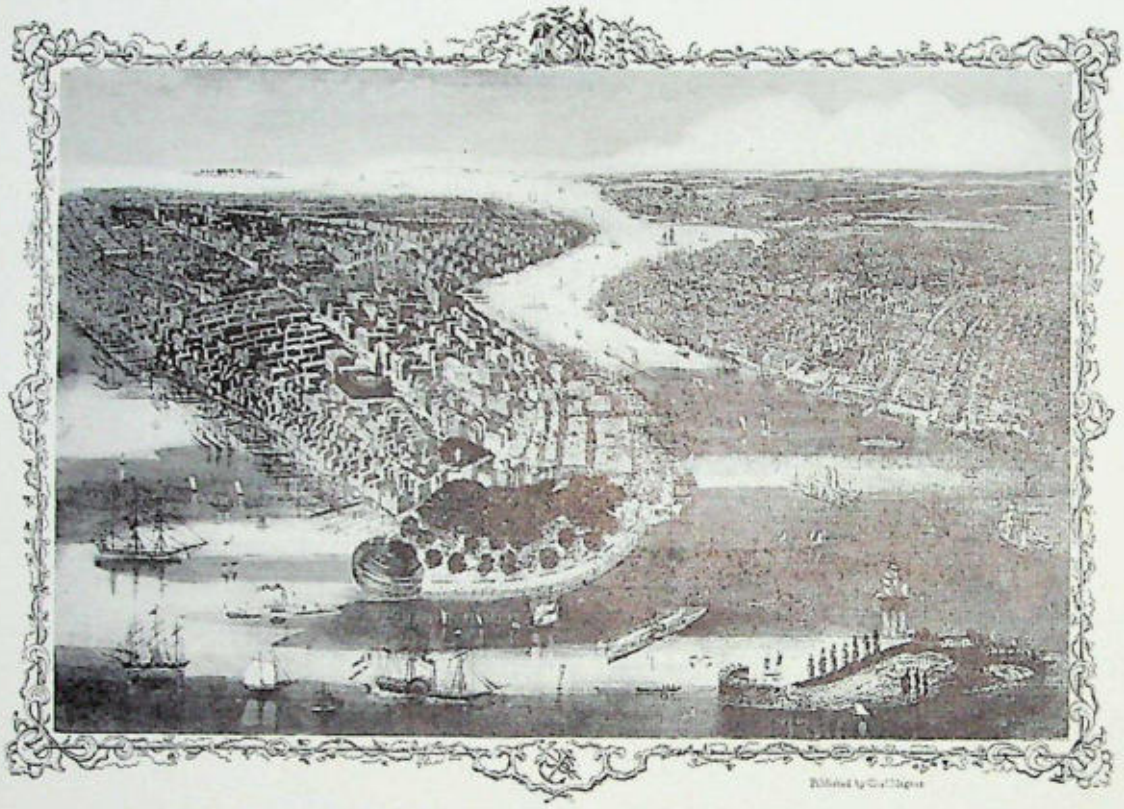
Mr. Brooks is to be both thanked and congratulated for his public spirit in providing a place where the serious worker may hide away and carry on researches on local forms, secure from well meaning but over-exuberant recreationists. There is no charge attached to the use of the facilities provided whatsoever, but applicants must have proper credentials and show that their presence is definitely for the pursuit of some tangible problem. Applications may be addressed to Mrs. R. B. Breder, Wyanokie, Zoological Station, Haskell, New Jersey.—*C. H. T.*

Local Marine Fishes.—A new volume has just been added to the "New York Aquarium Nature Series." It is entitled "The Marine Fishes of New York and Southern New England" and has been prepared jointly by J. T. Nichols of the American Museum of Natural History and C. M. Breder, Jr., of the Aquarium.

There has been a twofold purpose in preparing, first to supply the public with a condensed account of all that is known concerning the local sea fishes and second to have at hand a ready reference to aid in answering the thousands of questions yearly asked of both institutions concerning these fishes. It is obviously not possible or desirable for any one individual to carry around mentally all such data which concerns the two-hundred and sixty-one species known from our nearby shores.

One of the features of the book designed to appeal to amateur naturalists and anglers is the reduction of technical terms to a minimum. Another is the presentation of character sketches of each of these two-hundred odd species, intended to aid the novice in identifying his fish. It is curious to note that this is the first attempt to figure all of the local species under one cover. Aside from this feature the emphasis has not been laid so much on the mere cataloging of the species, but rather on discussing what is known of their life habits, foods, development, etc. All sources have been drawn upon, but much of the material is original. Nearly all of the questions ordinarily asked by visitors at the Museum or Aquarium concerning these fishes are answered in this book. A failure to mention a given fact about a species implies a lack of knowledge concerning it, in our waters at least. Thus the volume,

Aquarium at Nice: An interior view of one of the galleries.



Castle Garden, now the New York Aquarium.
From an old print.

as well as making available the known data on each species, indicates what is still unknown and in the nature of desiderata.—*C. H. T.*

Spring Ailments of Fishes.—The work with the diseases of fishes, described in the last Aquarium Bulletin, is still going on, the collection of blue and black angel fishes, brook, brown and rainbow trouts, and black bass, having been treated and saved this spring. For many years the angels have gone, on the advent of spring, at the rate of four a day, and it took but a few days to empty their tank. This year the first one to die was diagnosed before it had fully stopped breathing, the trouble being trematodes sucking the blood out of the gills. Two others were too far gone to recover, but the remainder of the collection—seventeen in number—were all cured by prompt action, a bath in ten per cent silvol solution being immediately effective. An exactly similar infestation in the trouts was cured by two baths, one week apart, in ammonia solution, thirty-two drops to the gallon of water. The trouts, seventy in number, at once became extremely playful and pugnacious. Many other individuals of fresh and salt water have been treated and cured.

There have been so many requests for reprints of the paper published on this subject that an information leaflet will be prepared incorporating the results already described and containing data also concerning similar work elsewhere. Questionnaires sent to thirty-six other aquariums have thus far resulted largely in reports of no experiments made with the diseases of fishes.—*I. M. M.*

Tilefish.—The fishery for tilefish was practically abandoned during the war, as fishing vessels did not care to venture far from the coast. It is now being carried on profitably as there is an increasing demand for tilefish in the middle west, where catfish once exceedingly abundant there, becomes more scarce. The catch of tilefish in 1925 was 1,015,000 pounds; in 1926, 1,975,000 pounds, and during the first quarter of 1927, 944,000 pounds.

New York Zoological Society

OBJECTS OF THE SOCIETY

A PUBLIC ZOOLOGICAL PARK · A PUBLIC AQUARIUM · THE PRESERVATION OF OUR NATIVE ANIMALS · THE PROMOTION OF ZOOLOGY

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SABLE ANTELOPE . . . . . Cover

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Eland cow and her calf, which was born in the Zoological Park. The scene might be an African veldt, so few are the traces of civilization.

Photograph by Elwin R. Sanborn

ZOOLOGICAL SOCIETY BULLETIN

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WHAT IS AN ANTELOPE?

By H. E. Anthony

Curator Department of Mammals of the World
American Museum of Natural History

"There is such a wealth of splendid-looking antelopes to be found on the great African continent that it is hard, nay, impossible to say which amongst them is the grandest prize of all that can fall to the hunter's rifle. In bulk nothing approaches the eland, and an old bull of this species, with his massive form, low-hanging dewlap, and great neck surmounted by a striking and beautifully proportioned head, is in truth a noble animal, but at the same time one that looks fitter in every way to adorn a park than to be hunted to the death. The eland is, in fact, one of those beasts that ought to have been trained to the service of man, and would have been in all probability had it existed in Asia instead of in Africa. Such an animal few can slay without a certain feeling of regret, for even when desparately wounded, nothing but reproach can be read in its mild dark eyes."

African Nature Notes and Reminiscences, F. C. Selous.

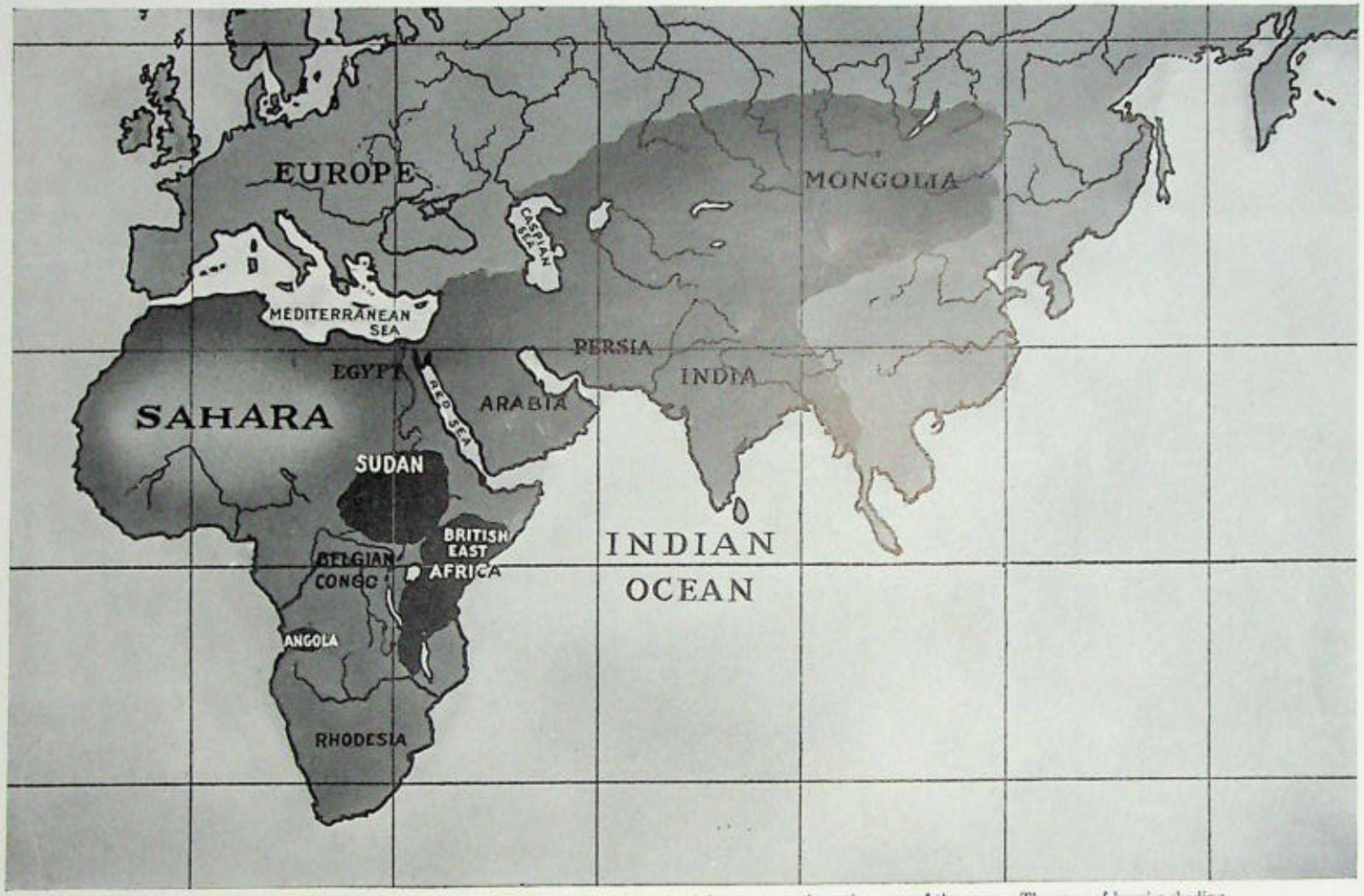
THE journals and accounts of pioneers, explorers, and trappers tell us that North America once teemed with game. Deer and elk were plentiful, while pronghorn antelope and bison roamed the plains in great numbers, especially the latter, the numbers of bison almost passing belief. However, this display of mammal life probably never in historical times equaled that to be seen in Africa and, although even in the dark continent the exterminating forces of the twentieth century are making themselves manifest, it is yet possible to see there vast assemblages of mammals in such great hordes that one is forced to wonder what Africa must have been in its original and primitive condition.

By far the greatest part of this assemblage of mammals is made up of the antelopes, which exceed all other groups not only in number of individuals but in variety of form, and in Africa they have apparently reached a peak of evolution which they have never attained elsewhere.

The term antelope is used for a great number of more or less closely related forms. It is usually applied to any member of the family *Bovidae*, which is not an ox, sheep, or goat. However, there is more difference between some of the antelopes than there is between certain antelopes and the oxen or goats for example, and the name antelope is very comprehensive.

Antelopes are hoofed, ruminant mammals having two toes, and with horns—on the males at least, often on both sexes—which arise from the frontal bones. False hoofs may be present or absent, but are never well developed. The horns are hollow, chitinous shells supported on bony cores, and it is chiefly in the character of the horns that antelope differ from deer. The permanent, bony core of the antelope horn corresponds to the deciduous, bony antler of the deer.

The present-day distribution of antelope is, as may be noted on the map on page 84, African and Asiatic. Our American pronghorn, although called an antelope, is really a member of quite a distinct family, the *Antilocapridae*, and not very closely related to the Old World or true antelopes. The Rocky Mountain goat is more closely related to the African antelopes than is our pronghorn, for this so-called goat is a mountain antelope, kin to the chamois, and a true member of the *Bovidae*. The fossil records for the New World do not shed any great amount of light on a possible previous inhabitation of America by antelope related to the Old World types. The few fossils known are so fragmentary that no



Distribution of the Antelopes. The dark area over Africa and southwestern Asia represents the entire range of the group. The areas of heavier shading in Africa indicate the principal regions of greatest abundance, although there are other spots, such as the region about Lake Chad and along the west coast, where antelope are nearly as abundant. The reader should note that while the map indicates a shaded area in Asia about equal to that in Africa, the number of antelope, both individuals and species, is far greater in the latter continent. The distribution of antelope in Asia is extensive, but only a mere sprinkling compared to the concentration of individuals in Africa.

conclusive deductions may be drawn from them, and it is quite probable that the Americas never had antelope of the type seen today in Africa and Asia. Certainly there is nothing to show that they were a dominant feature of the fauna if they did occur in the Americas.

The antelope are classified under several large heads or subgroups within the family *Bovidae*, and it is necessary to grasp a few of these fundamental relationships and differences before the confusing array of beasts that parade under the blanket name of antelope resolves itself into hartebeest, bushbuck, waterbuck, oryx, sable, gazelle, etc.

The sable, roan, and oryx antelopes belong to the egocerine group or subfamily. These are antelopes of large size, horned in both sexes, the horns either straight (oryx), evenly curved backward (roan and sable), or spirally twisted (addax). They are splendid beasts standing higher at the shoulders than the rump, maned on the neck, and do not have conspicuous glands in front of the eye. The ears are long, the face is marked with stripes, and the tail is long and tufted. This subfamily contains antelopes of sufficiently aggressive disposition to be considered dangerous when wounded. Roan, sable, and oryx are all liable to charge under the proper conditions, and the general experience of the zoological parks is that these animals are fierce and intractable.

The head of a full-grown, male sable antelope is one of the finest trophies that the sportsman can bring out of Africa. The record horns for sable (Varian's sable antelope of Angola) are, according to Rowland Ward, 64 inches long—a length of horn reached or exceeded only by the greater koodoo. The horns rise abruptly from the head and curve back in a sweeping, scimitar-shaped arc, in marked contrast to the long curved horns of the oryx, for example, which arise at a low angle with the head. The roan antelope is almost a red counterpart of the dark colored sable, but differs in having smaller horns, longer ears, and slightly greater body size.

The genus *Oryx* includes a number of forms such as the beisa, the gemsbuck, the beatrix antelope, and the white oryx, all of which bear a strong family likeness to one another and are readily recognized as oryx, having the long, slender horns, striped face, and pale gray to whitish coloration. Oryx are desert antelope and show a preference for the drier sections. The leucoryx, or white oryx, is found on the southern Sahara, and the beatrix finds a home on the deserts of Arabia. The name oryx appears in the works of Aristotle, Pliny, Oppian, and other ancient writers, and in some cases, at least, the animal may be certainly identified as a member of the group we know today as oryx.

One of the most important of the antelope subfamilies is the *Bubalinae*, which includes the hartebeests, wildebeests or gnus, and the topis and tiangs. This group is important because of the fact that its members are probably the largest numerical part of the vast herds of African game; they include some of the most grotesque and highly specialized antelopes; and they are widely ranging plains types certain to be encountered by anyone who travels in Africa.

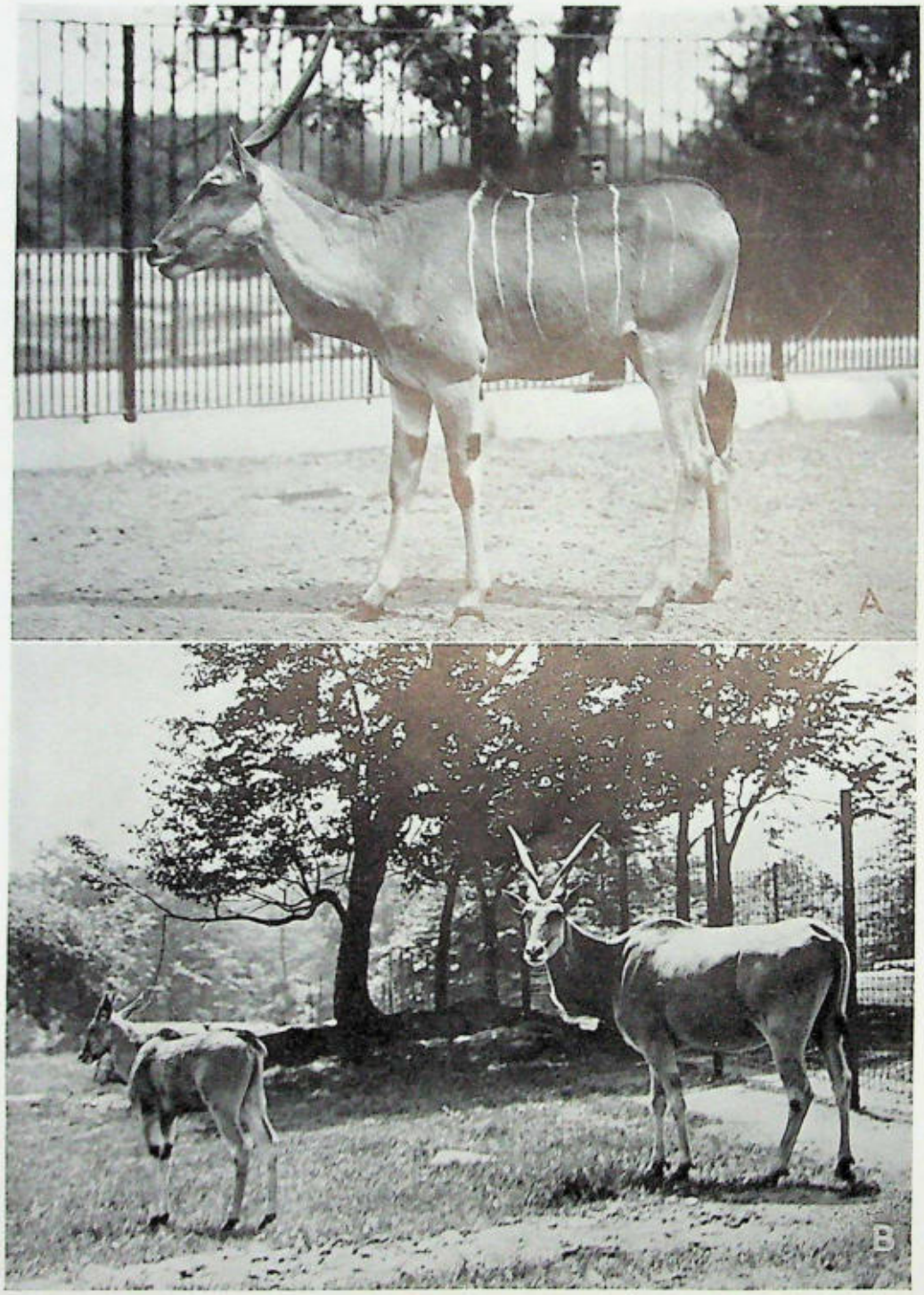
The bubaline antelope may be known by the long head (especially elongated in the snout region), narrow ears, reduced facial glands, high withers, and long, tufted tail. Both sexes carry horns which, in the case of the gnus and hartebeests, are of such characteristic shapes that they need be confused with no other antelopes.

The waterbucks, kobs, lechwes, and reedbucks, members of the subfamily *Kobinae*, are widely distributed African antelope, only the males of which are horned. The horns are simple in pattern, being cylindrical, ringed with low ridges over much of their length, and curving in a long sweep without abrupt change of direction. Probably the picture brought to the mind of the average laymen by the word antelope conforms closest to some member of this group. These antelope are medium to large in size.

The subfamily *Tragelaphinae* includes the elands, bongos, koodoos, bushbucks, and situtungas, all of which have horns that show spiral twisting. In the case of the eland and bongo, both sexes are horned, but in the rest of the group only the males bear horns. This group has one Asiatic member, the nilgai. The tragelaphine antelope are not high at the withers, contrasting in this respect with the roan, oryx, hartebeest, etc., have no lachrymal gland, are more or less marked with transverse white stripes on the body, and usually have other white markings on cheeks, lips, chin and legs. The range in size is from the eland, largest of all the antelope, down to the small bushbucks which are only about four feet in length. The variation in horns is equally great, the horns of the greater koodoo vieing with or exceeding those of the giant sable as the largest and most spectacular of all antelope horns.

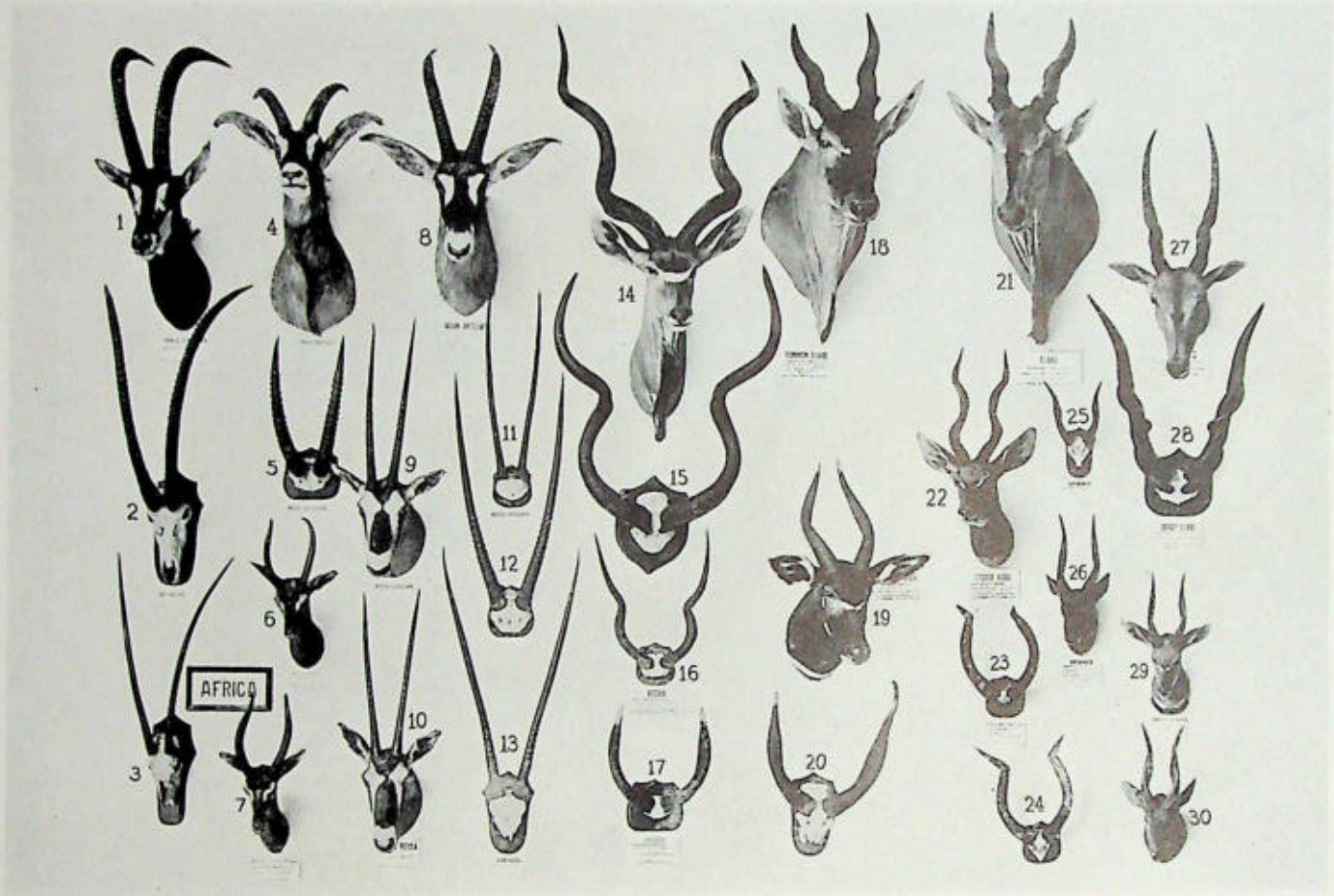
In the subfamily *Antilopinae* are placed the gazelles, a large group of slender, graceful antelope which vary greatly in size, color, and pat-

The common eland (*Taurotragus oryx*). The eland is the largest of the antelope and is as large as a domestic ox. One of the characteristic features of this animal is the broad fold of skin or dewlap which hangs down from the mid-line of the neck. The giant eland differs from the common eland in being slightly larger.



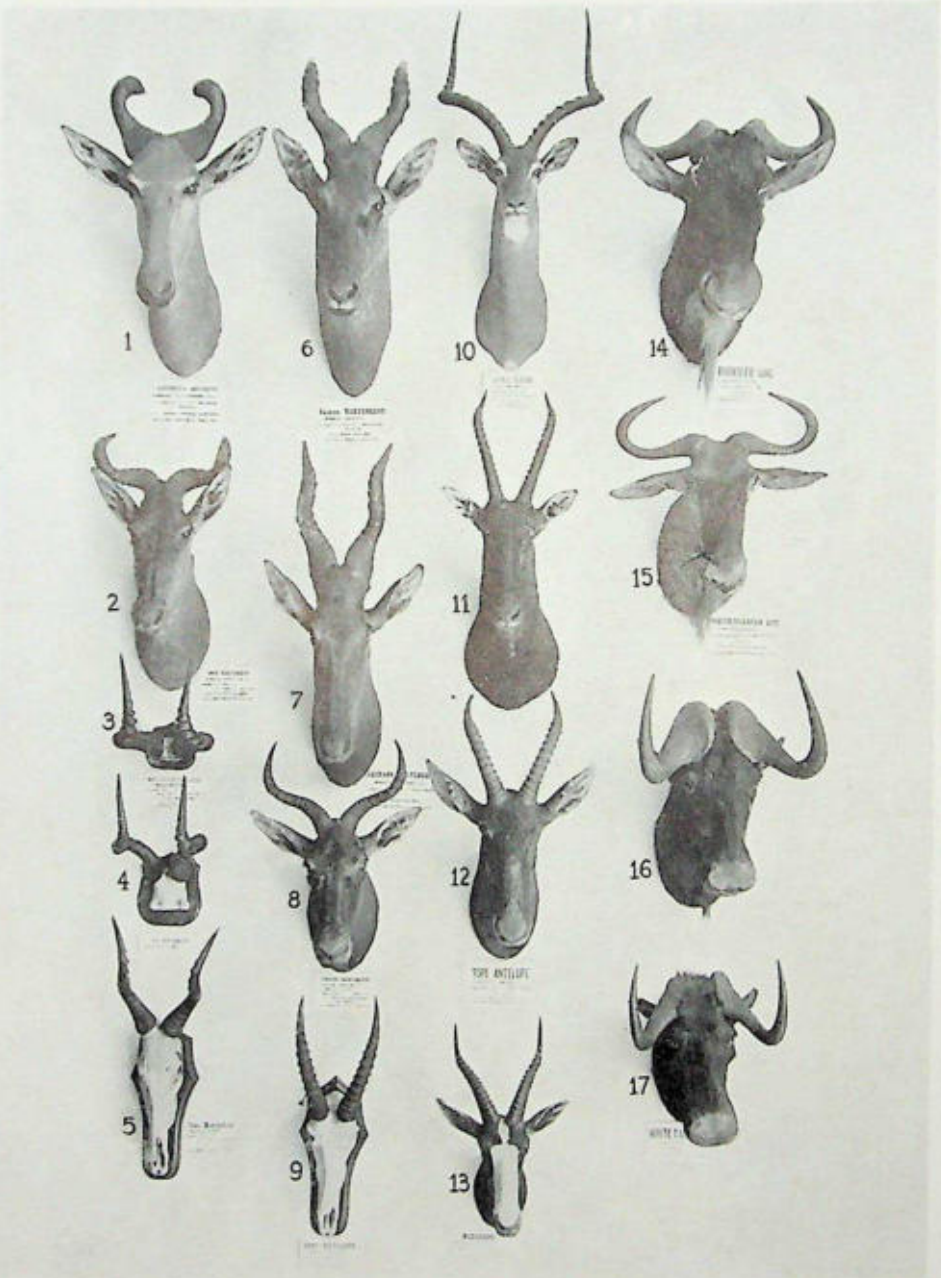
A. The striping on the body of the eland is generally more conspicuous on young animals. B. The horns of the female eland are not as heavy nor as twisted as those of the male.

Photographs by Elwin R. Sanborn



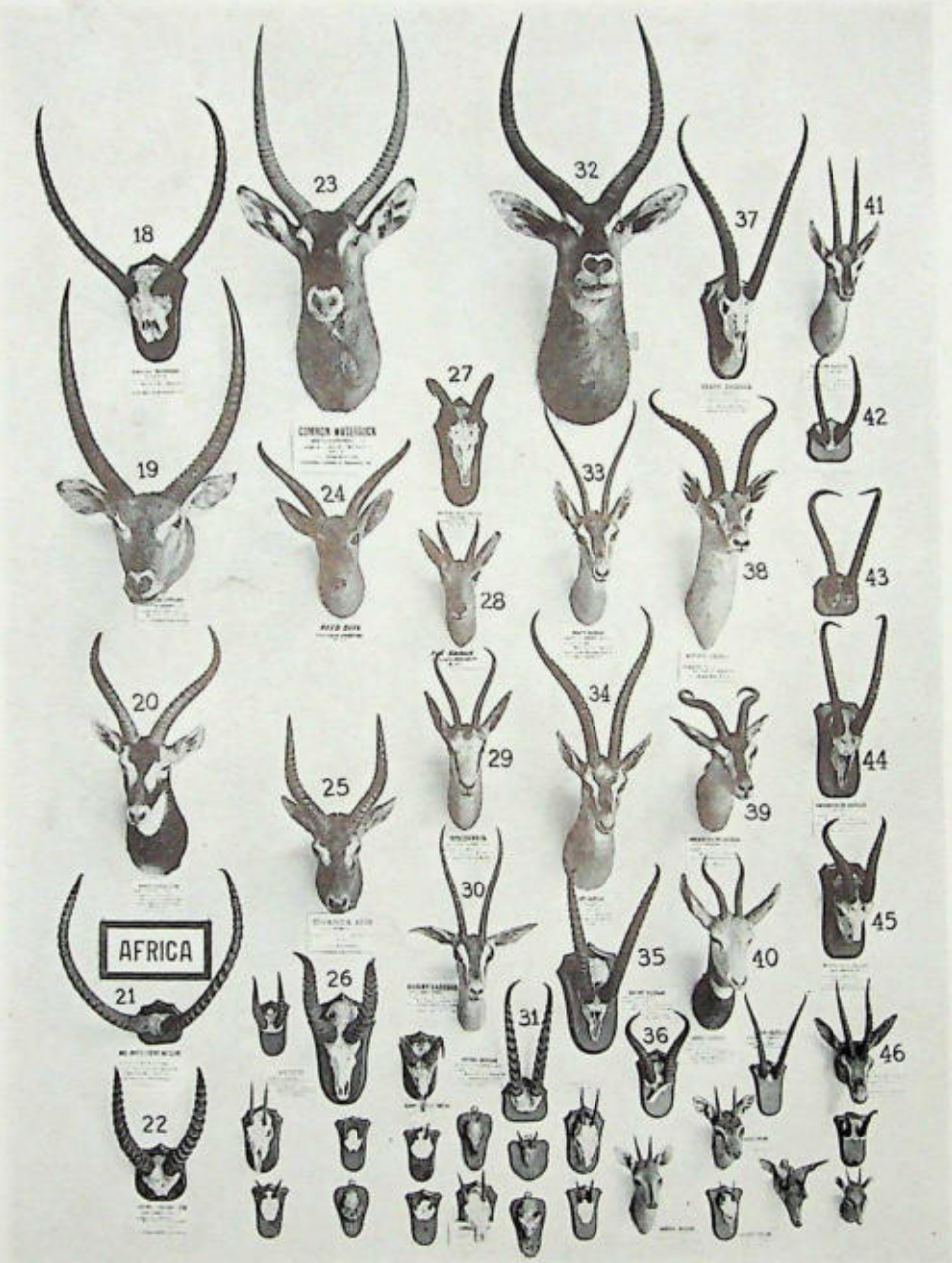
1 and 2. Sable antelope, male (*Egocerus niger*)
3. Leucoryx (*Oryx leucoryx*)
4, 5, 8. Roan antelope (*Egocerus equinus*)
6 and 7. Waller gazelle or gerenuk (*Litocranius walleri*)
9, 10, 11. Beisa (*Oryx beisa*)
12, 13. Gemsbuck (*Oryx gazella*)
14, 15. Greater koodoo (*Strepsiceros strepsiceros*)
16. Addax (*Addax naromaculatus*)
17, 20. Bongo (*Boocerus eurycerus*)
19. Bongo, female (*Boocerus eurycerus*)
18, 21. Eland, male (*Taurotragus oryx*)
22. Lesser koodoo (*Strepsiceros imberbis*)
23, 24. Impala (*Tragelaphus angasi*)
25, 26. Bushbuck (*Tragelaphus*)
27. Eland, female (*Taurotragus oryx*)
28. Derby eland (*Taurotragus derbianus*)
29, 30. Bushbuck (*Tragelaphus scriptus*)

Photograph by Elwin R. Sanborn



1. Lichtenstein hartebeest (*Alcelaphus lichtensteini*)
2. Coke hartebeest (*Alcelaphus major*)
3. Western hartebeest (*Alcelaphus cokei*)
4. Cape Hartebeest (*Alcelaphus caama*)
5. Tora hartebeest (*Alcelaphus tora*)
6 and 7. Jackson hartebeest (*Alcelaphus lelwel jacksoni*)
8. Swayne hartebeest (*Alcelaphus tora swaynei*)
9, 11 and 12. Topi hartebeest (*Damaliscus jimela*)
10. Pallah or impalla (*Aepyceros melampus*)
13. Blesbok (*Damaliscus albifrons*)
14. Brindled Gnu (*Connochaetes taurinus*)
15. White-bearded gnu (*Connochaetes albojubatus*)
16 and 17. White-tailed gnu (*Connochaetes gnu*)

Photograph by Elwin R. Sanborn

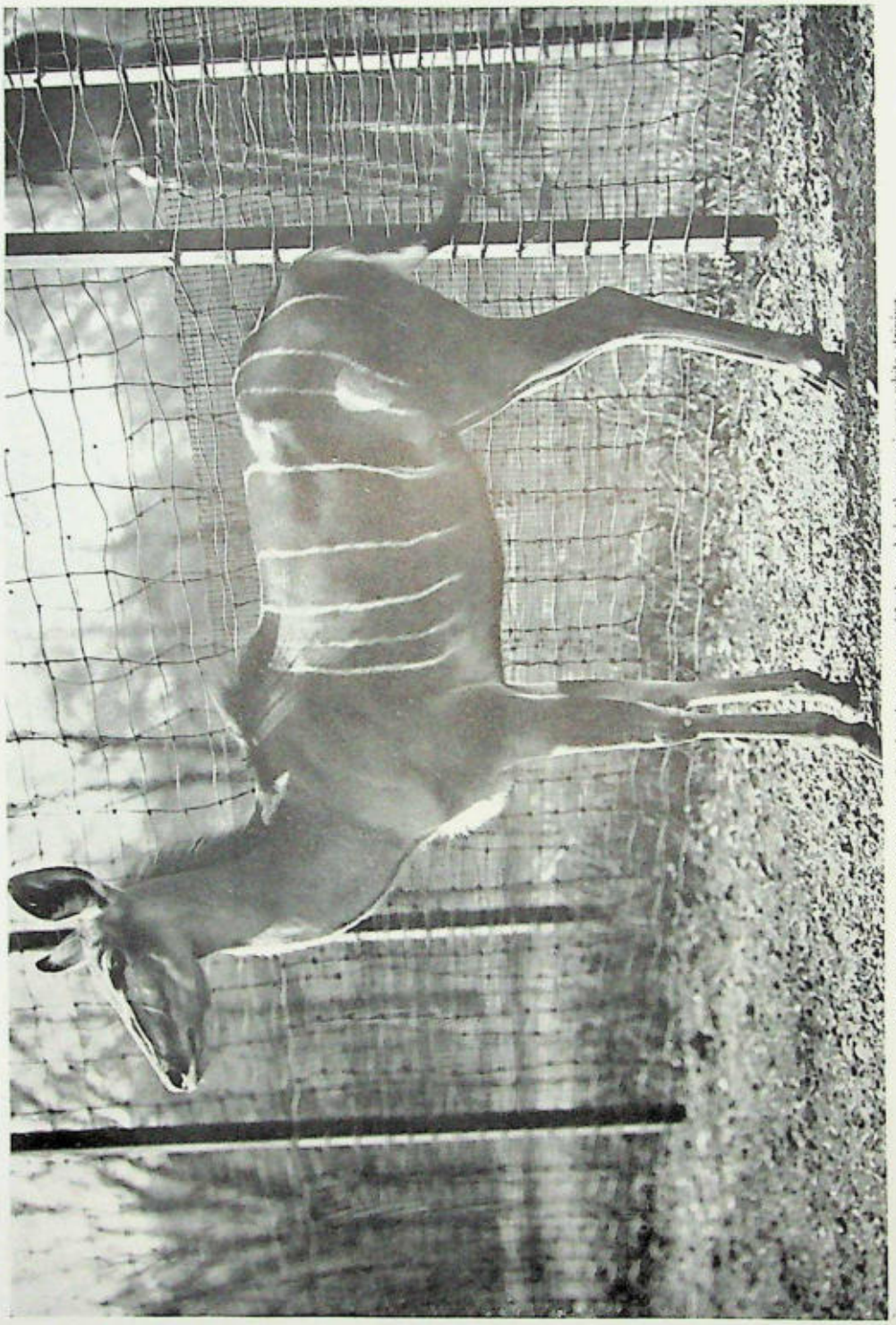


18 and 19. Lechwe (*Onotragus leche*)
20. White-eared kob (*Adenota kob*)
21. Mrs. Gray's lechwe or Nile lechwe (*Onotragus megaceros*)
22 and 25. Uganda kob (*Adenota thomasi*)
23 and 32. Common waterbuck (*Kobus ellipsiprymnus*)
24. Reedbuck (*Redunca arundinum*)
26. Puku (*Kobus vardoni*)
27. Bohor reedbuck (*Redunca bohor*)
28. Mountain reedbuck (*Redunca fulvorufula*)
29. Angola springbuck (*Antidorcas angolensis*)
30. Bright gazelle, female (*Gazelle granti brighti*)
31. Peters gazelle (*Gazelle petersi*)
33. Grant gazelle, female (*Gazella granti granti*)
34. Grant gazelle, male (*Gazella granti granti*)
36, 40, 45. Addra gazelle (*Gazella dama*)
37. Grant gazelle, male (*Gazella granti granti*)
38. Robert's gazelle, male (*Gazella granti roberti*)
39, 43, 44. Soemmerring gazelle (*Gazella soemmerringi*)
41. Thomson gazelle (*Gazella thomsoni*)
42. Dorcas gazelle (*Gazella dorcas*)
46. Speke's gazelle (*Gazella spekei*)

Photograph by Elwin R. Sanborn

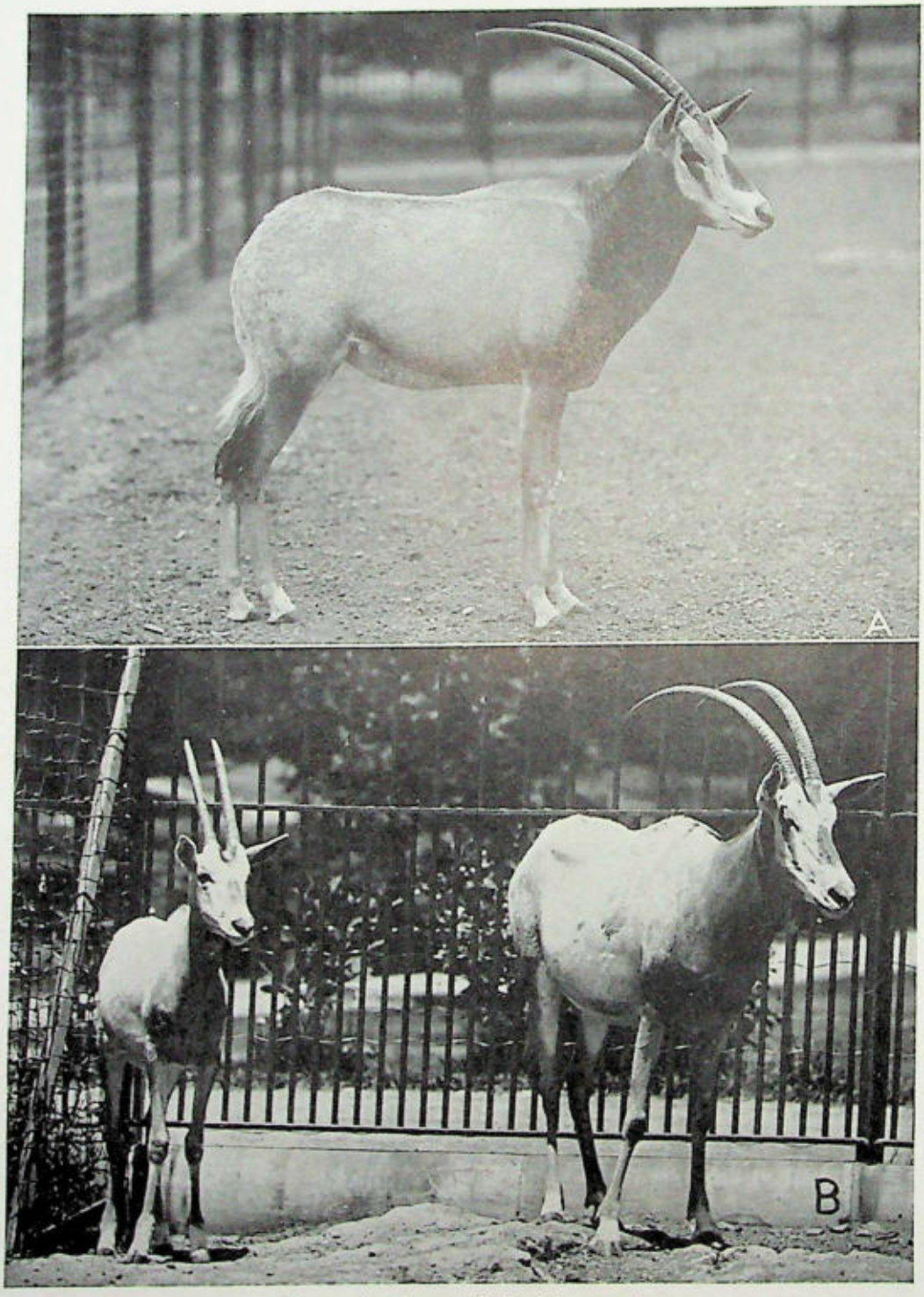
Greater Koodoo (*Strepsiceros strepsiceros*). The horns of an old male koodoo have been known to reach 71 inches in length along the curve.

Photograph by Elwin R. Sanborn



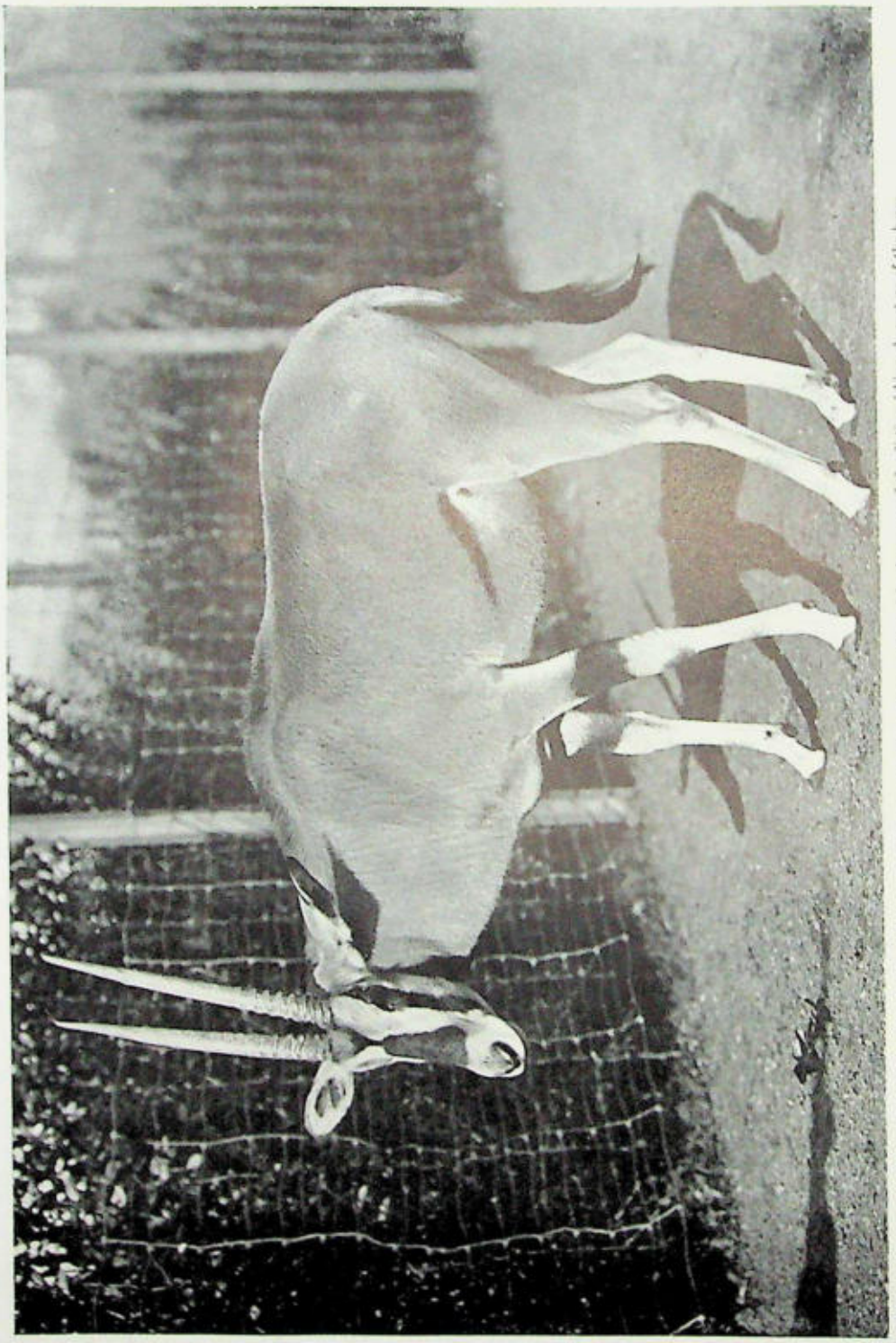
The female koodoo (*Strepsiceros*) is hornless but agrees with the male in the conspicuous white stripings.

Photograph by Elwin R. Sanborn



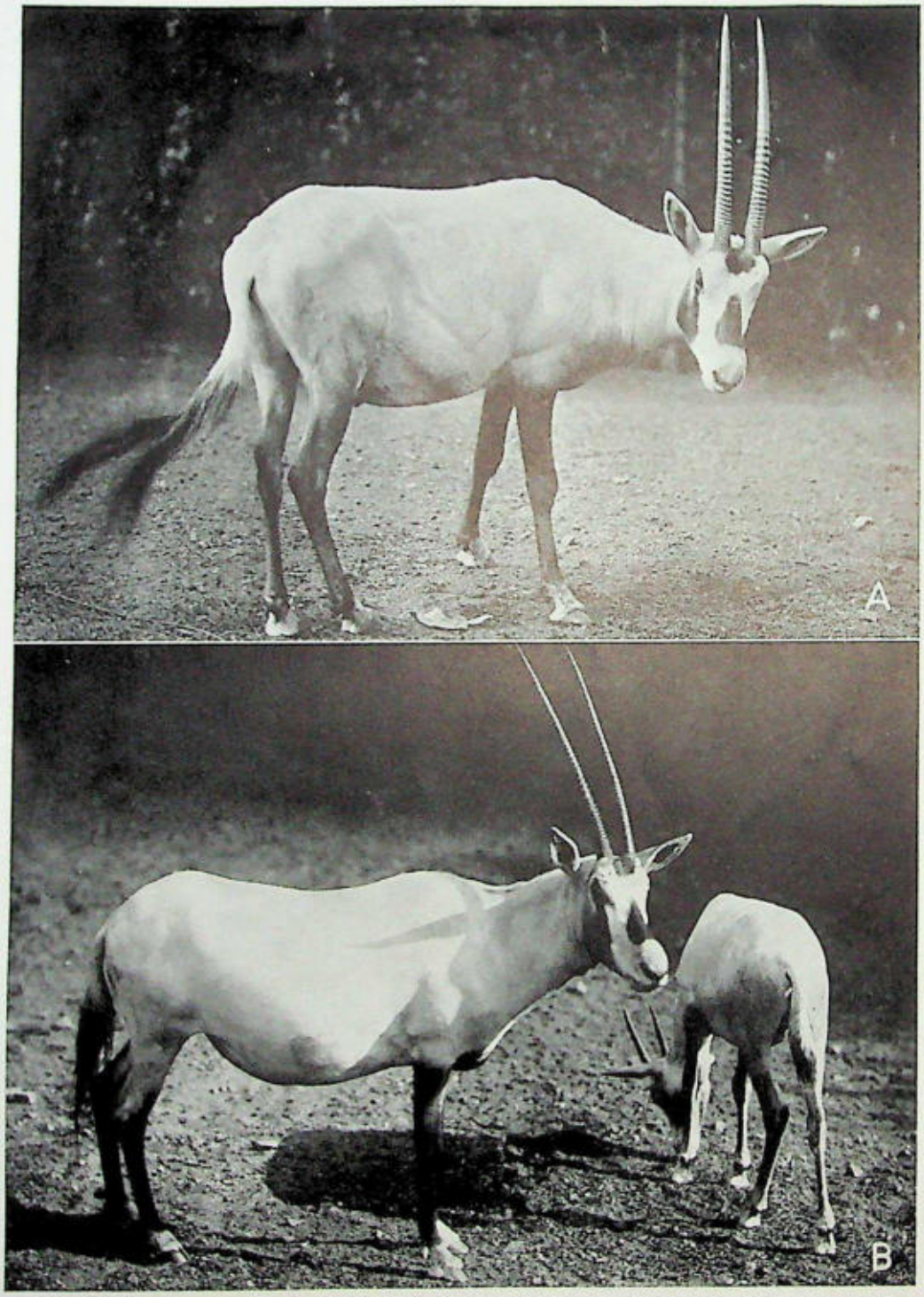
A. Female leucoryx (*Oryx leucoryx*). B. Female leucoryx with young.

Photographs by Elwin R. Sanborn



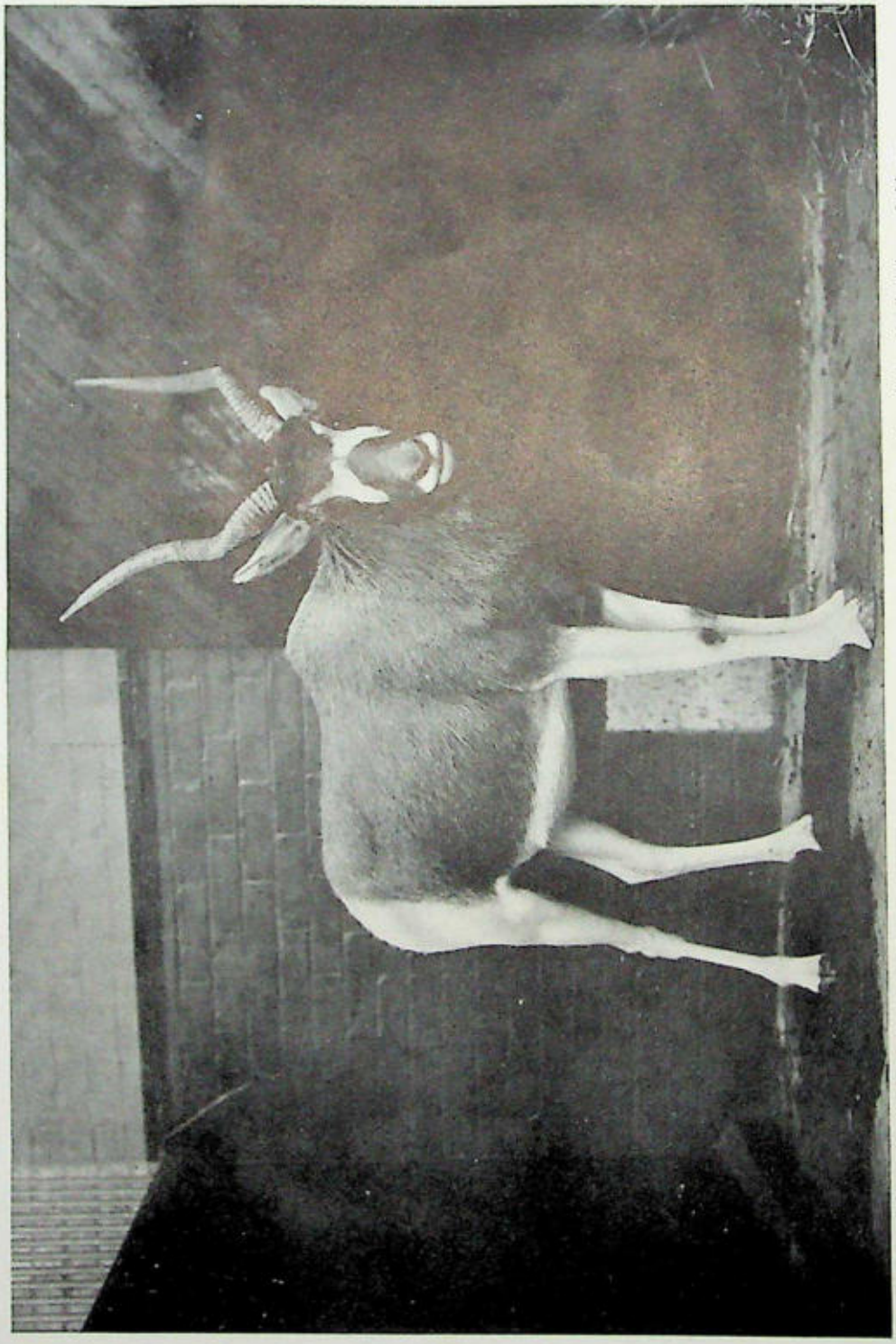
Male beisa (*Oryx beisa*). Note the contrasting black markings on the side and foreleg, one of the distinguishing characters of the beisa.

Photograph by Elwin R. Sanborn



A. Male Beatrix antelope (*Oryx beatrix*). B. Female Beatrix antelope with young. Among the Oryx the female frequently has longer horns than the male, although they are more slender.

Photographs by Elwin R. Sanborn

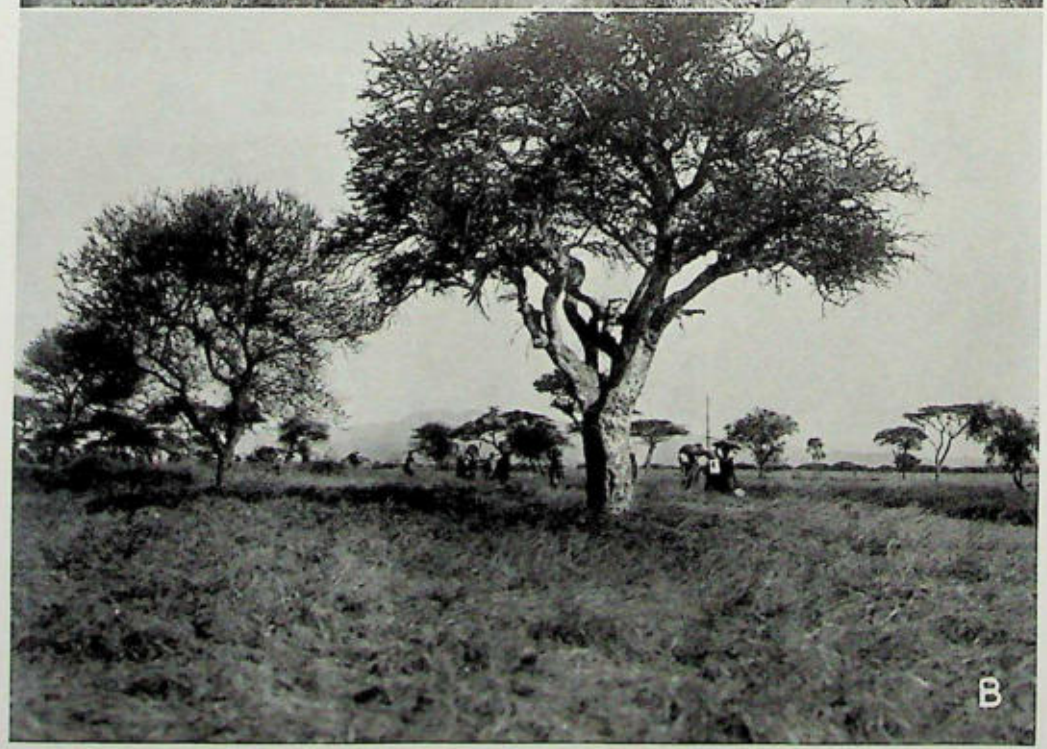


The Addax (*Addax nasomaculatus*). The addax is a member of the same group as the oryx but is the only antelope of this subfamily to have spiral horns. The addax lives on the deserts.
Photograph by Elwin R. Sanborn

A. Grass land along the Bahr el Ghazal, a tributary of the upper Nile. Such country as this supports great numbers of white eared kob and waterbuck. Photograph by Taylor Sudan Expedition of American Museum Natural History. B. Looking down on the Kaisoot Desert, Kenya Colony, the home of many varieties of antelope, such as greater and lesser koodoo (on hills) and gazelles (on desert). *Photograph Copyrighted by Martin Johnson, American Museum Natural History*

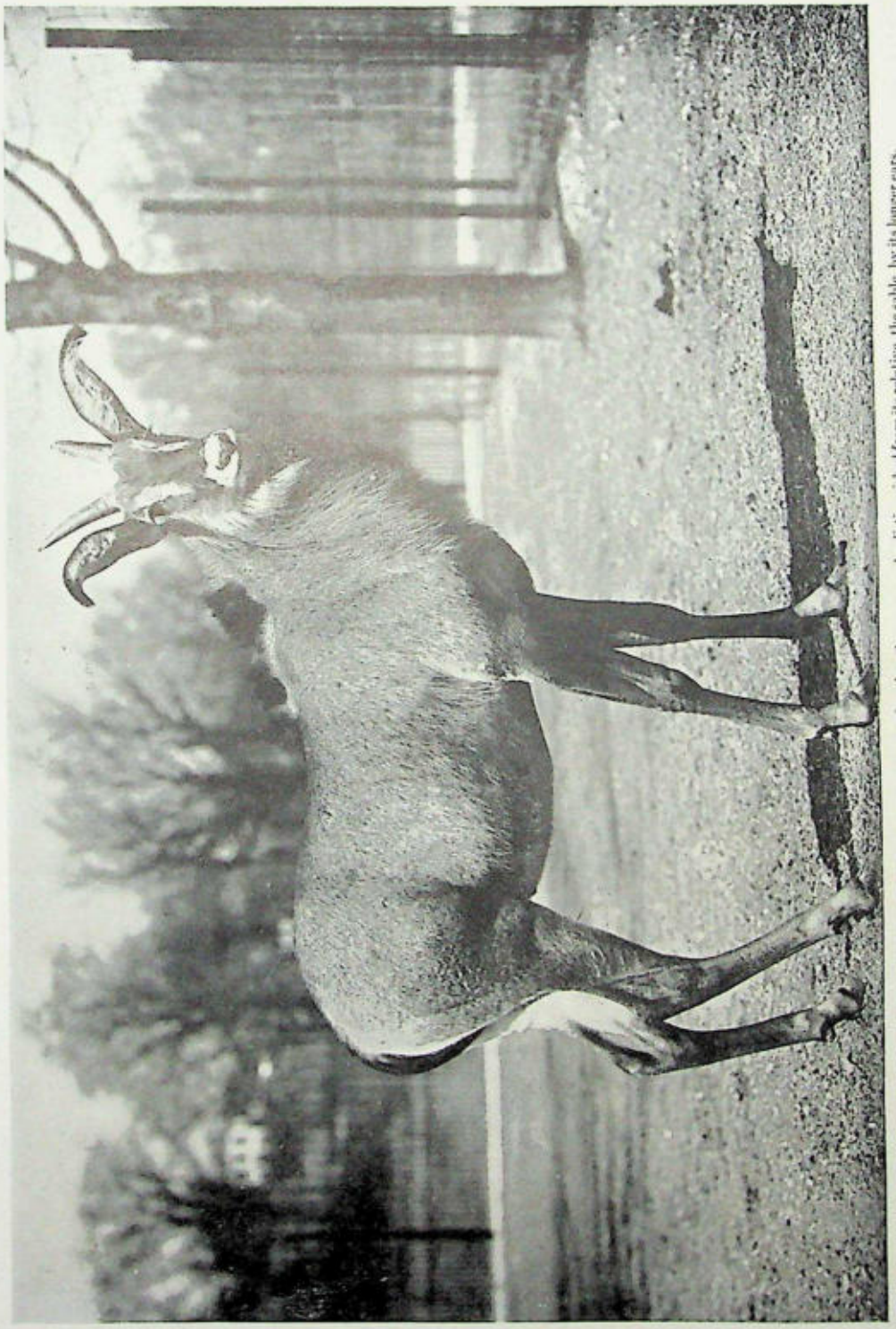
Male sable antelope (*Egocerus niger*). The sable is an alert, high-strung antelope and its fine carriage serves to identify it as far as it can be seen. Because of its high shoulders the sable has the appearance of being up on its toes and ready to dash off

Photograph by Elwin R. Sanborn



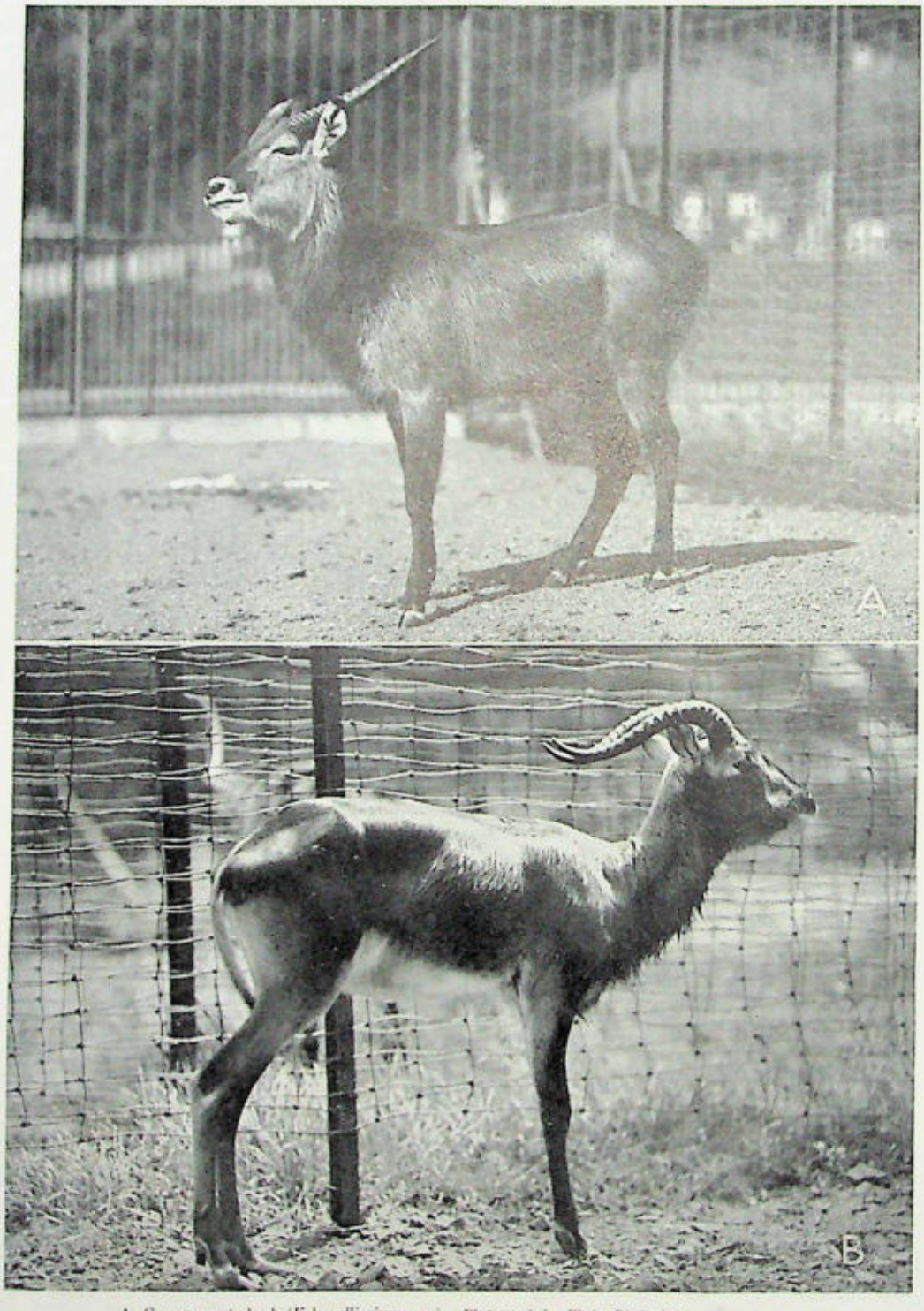
A. Where the Kenya Hills meet the Chobe Plains, Kenya Colony one finds antelope such as the klipspringer in the rocks and plains types like the impalla on the plains. B. The Isiolo Plains, Kenya Colony, typify the character of the country where great herds of antelope may be encountered.

Photographs Copyrighted by Martin Johnson, American Museum Natural History

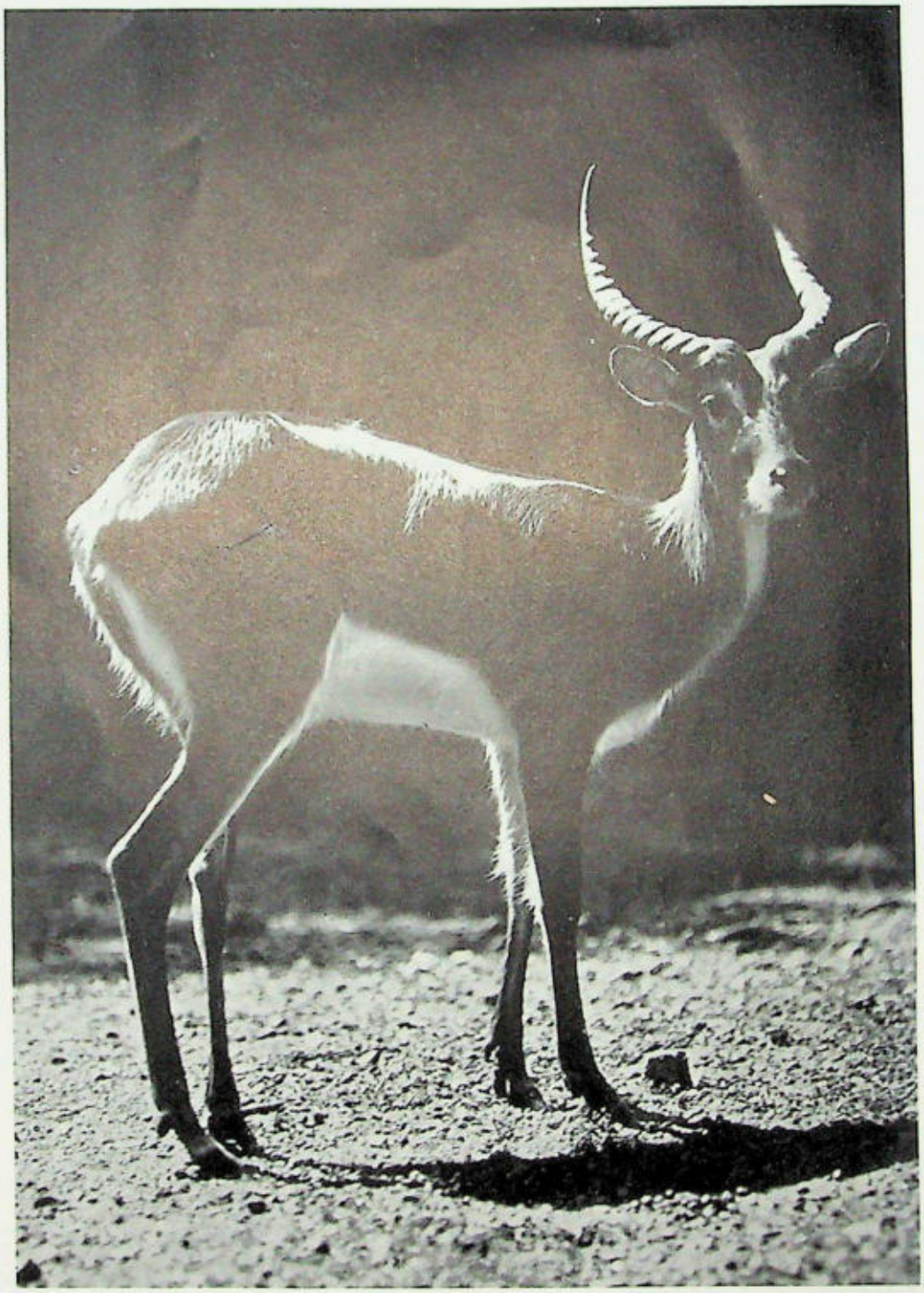


Young roan antelope (*Egocerus equinus*). Aside from the difference in color, the roan may be distinguished from its relative, the sable, by its longer ears.

Photograph by Ehrlich R. Sanborn

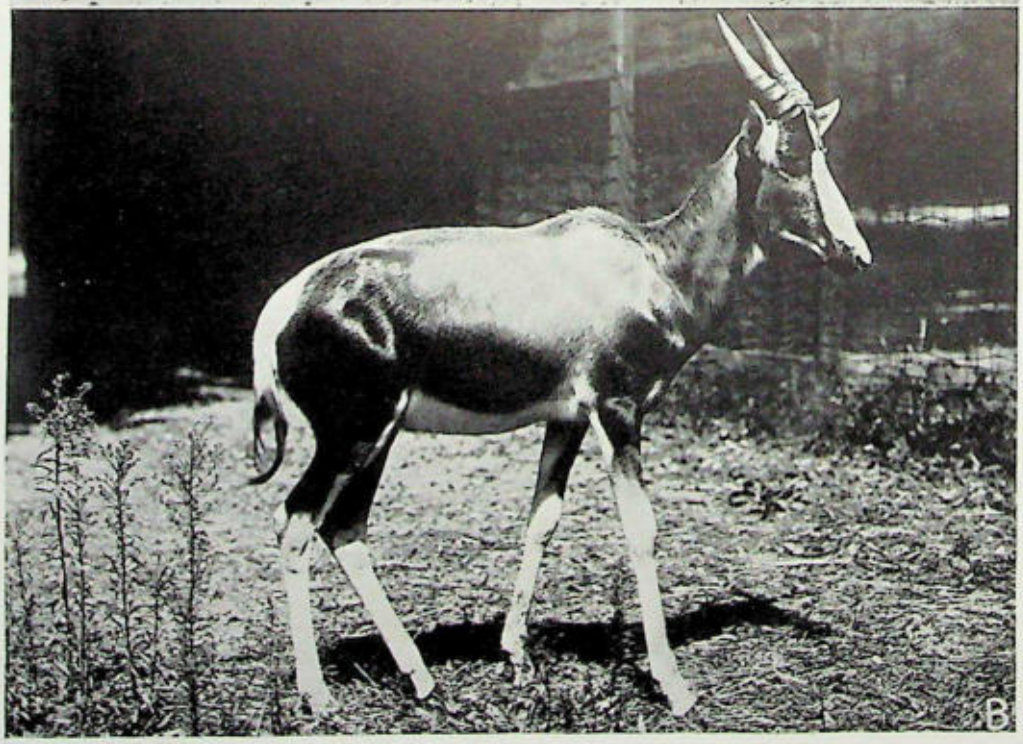


A. Common waterbuck (*Kobus ellipsiprymnus*). *Photograph by Elwin R. Sanborn*
B. Nile lechwe, often called Mrs. Gray's Kob or Mrs. Gray's waterbuck (*Onotragus megaceros*)
Photograph by F. D. Crosby



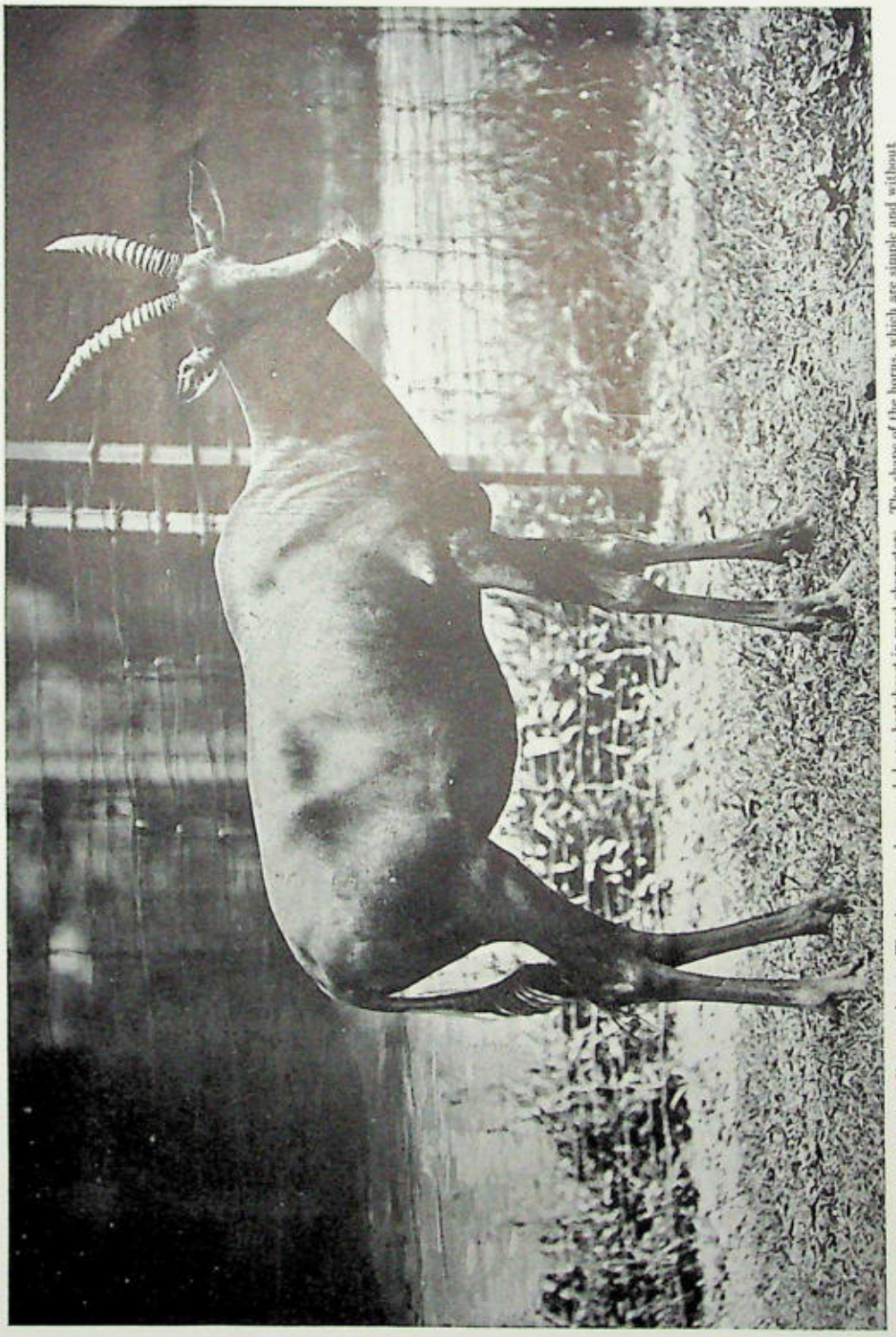
The lechwe (*Onotragus leche*). The lechwes are closely akin to the waterbucks but are rather limited in distribution, being found only along large rivers which have marshy or inundated banks.

Photograph by Elwin R. Sanborn



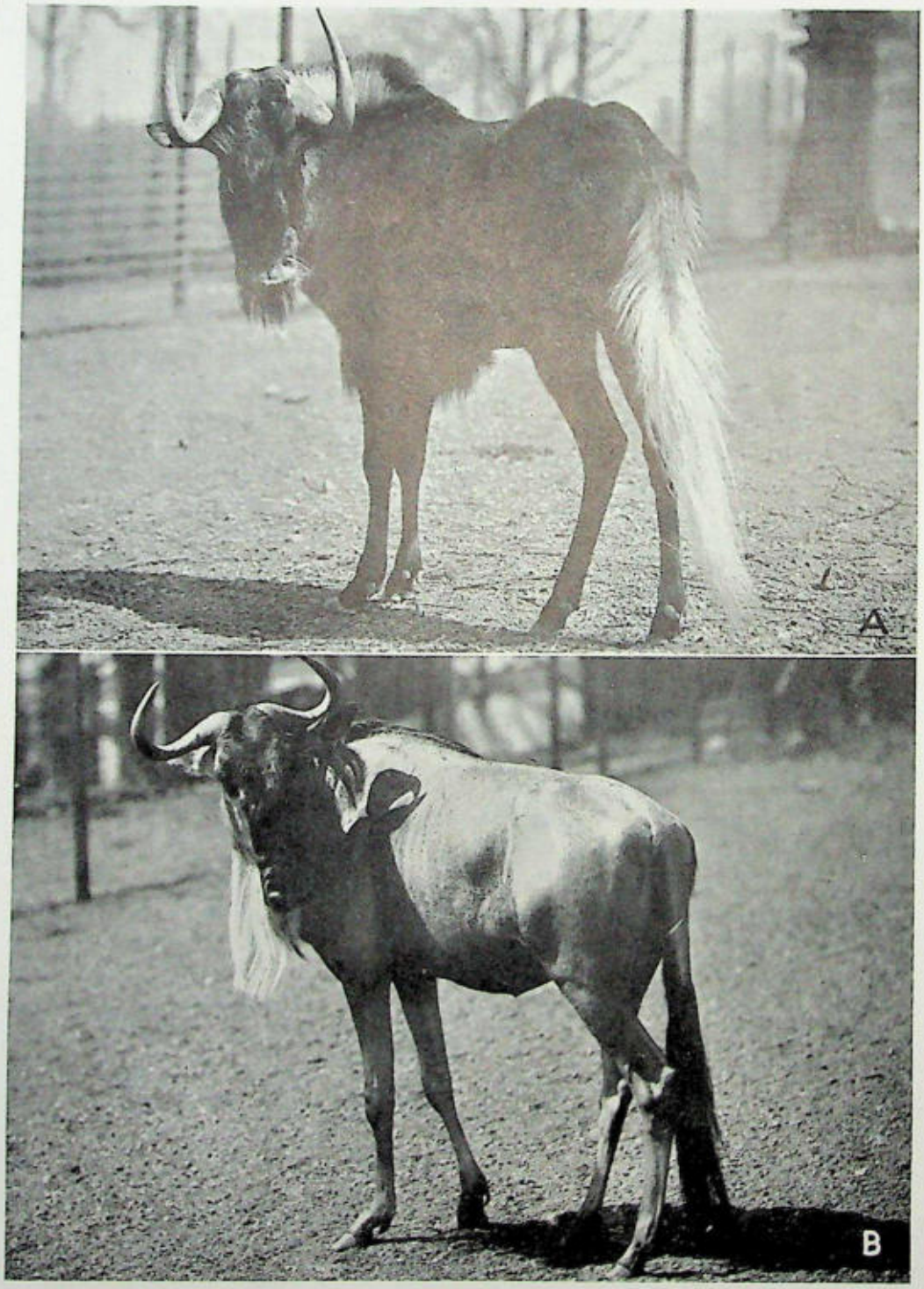
A and B. The blesbok (*Damaliscus albifrons*). The blesbok is unknown in the wild state today, the only living specimens being found on game reserves or in zoos. The blesbok is a close relative of the topi and tiang.

Photographs by Elwin R. Sanborn

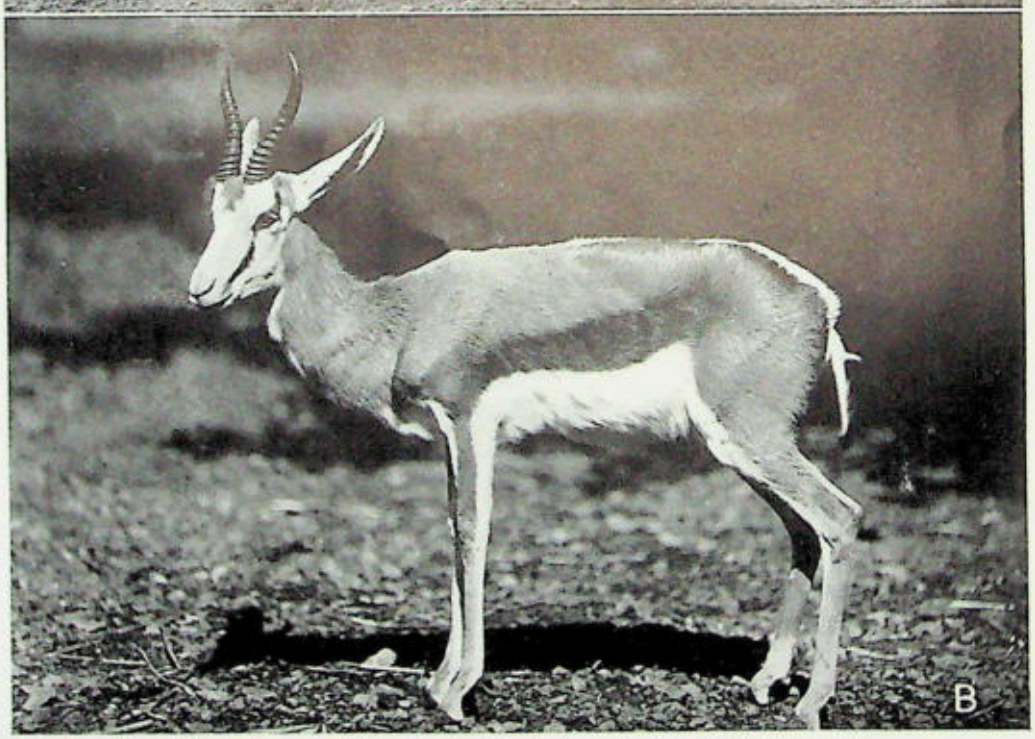


The tiang (*Damaliscus corrigum*). The tiang may be regarded as a hartebeest in most characters. The shape of the horns, which are simple and without abrupt curves, is one of the most obvious differences.

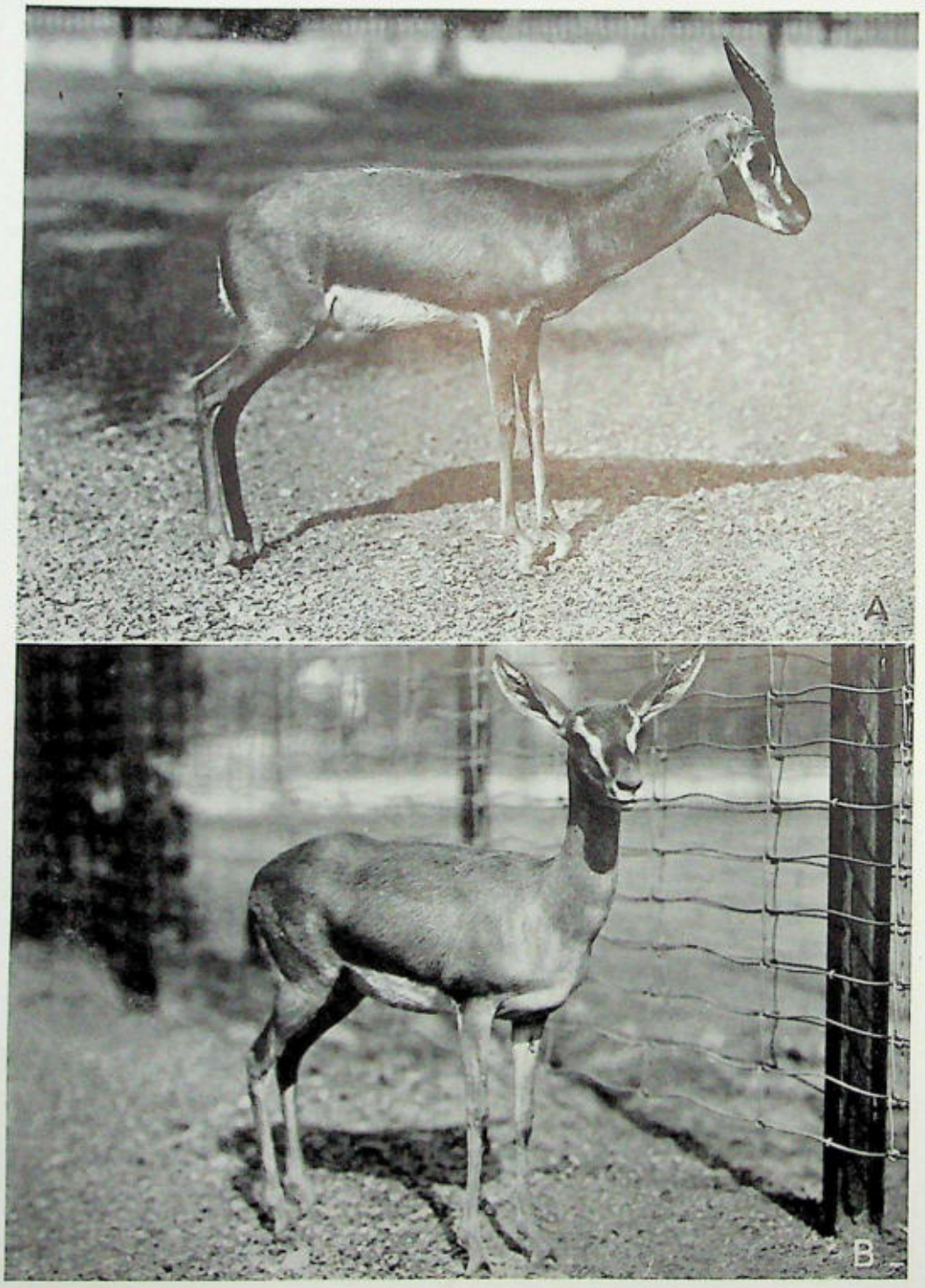
Photograph by F. D. Crosby



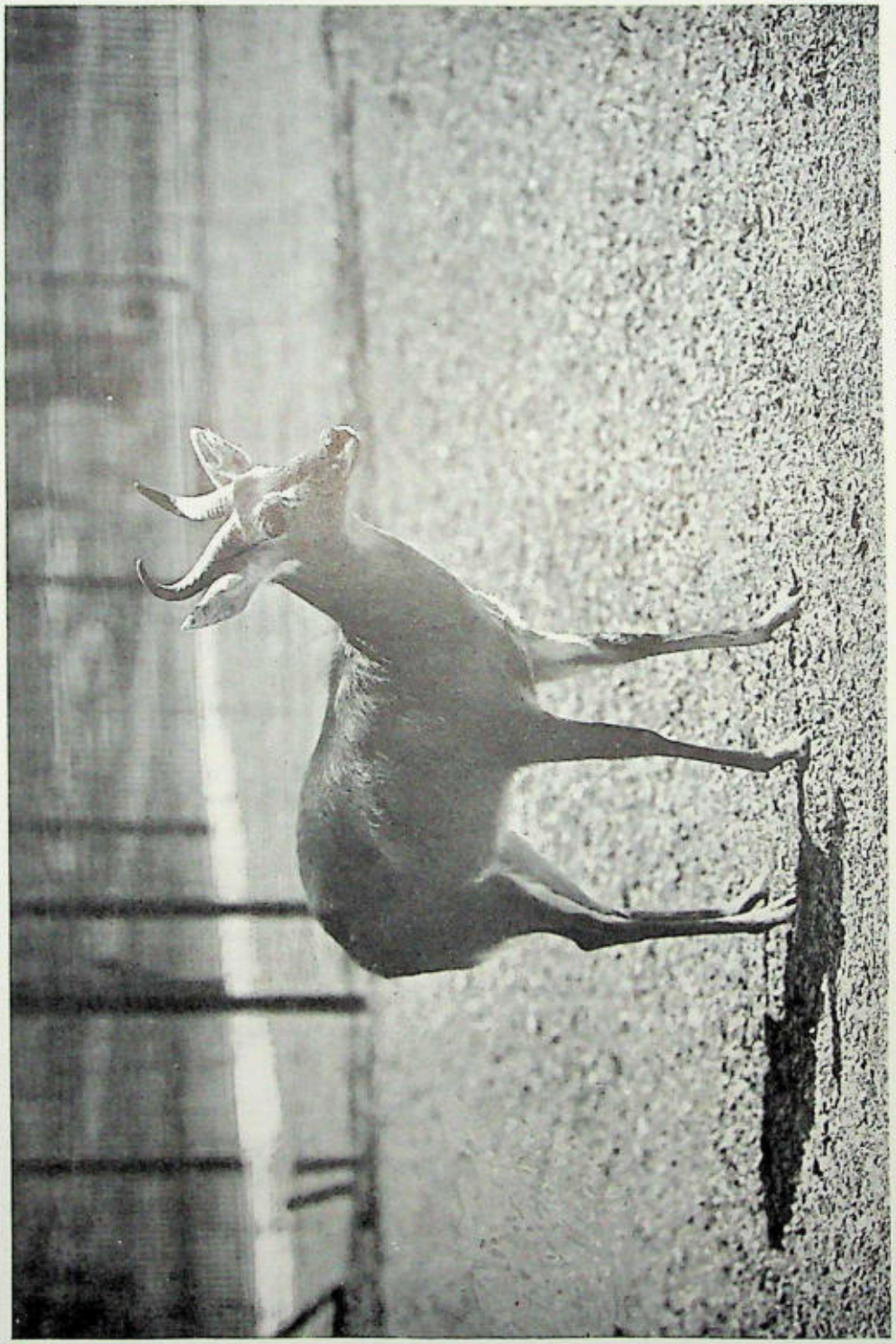
A. The white-tailed gnu (*Connochaetes gnu*). B. The white-bearded gnu (*Connochaetes albojubatus*).
Photographs by Elwin R. Sanborn



A. The addra gazelle (*Gazella dama*). A light-colored antelope of the desert. *Photograph by F. D. Crosby*
B. The springbuck (*Antidorcas marsupialis*) is a relative of the gazelles and placed with them in the subfamily Antilopinae.
Photograph by Elwin R. Sanborn

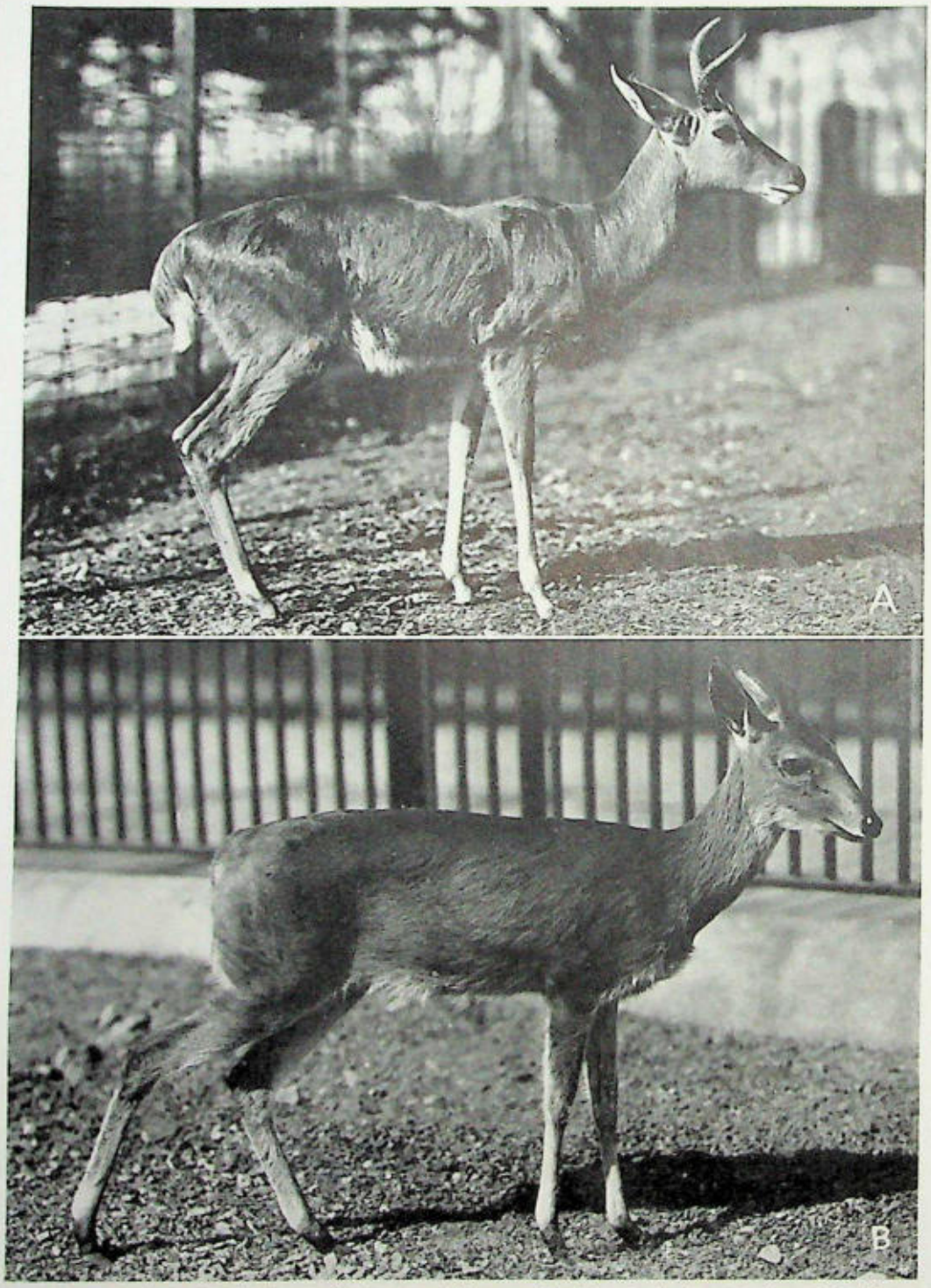


A. Male Dorcas gazelle (*Gazelle dorcas*). B. Young Dorcas gazelle with horns just budding.
Photographs by Elwin R. Sanborn

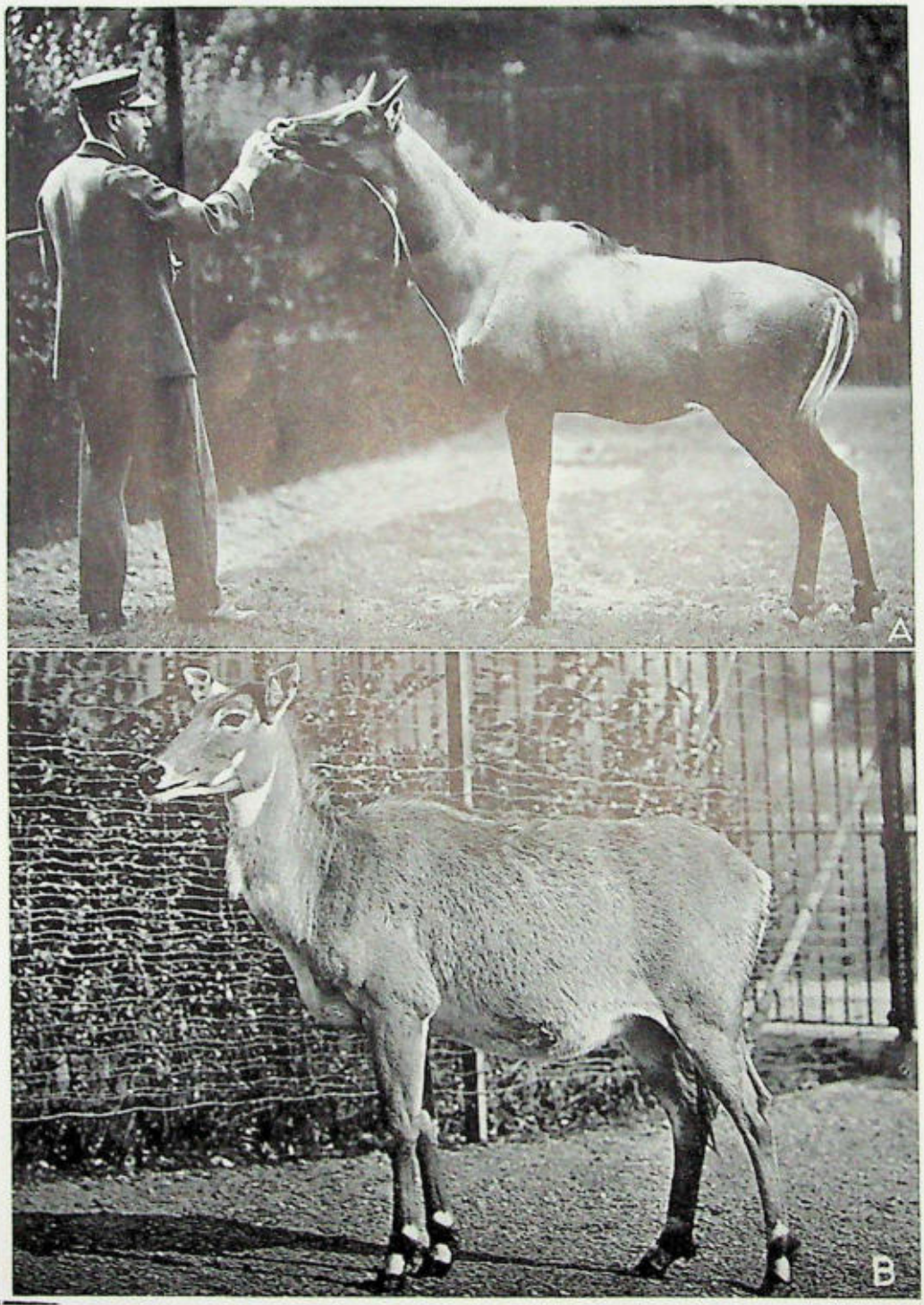


Male bohor reedbuck (*Redunca bohor*). The forward tipping of the horns distinguishes the bohor from other reedbucks, which have horns more nearly straight.

Photographs by Elwin R. Sanborn

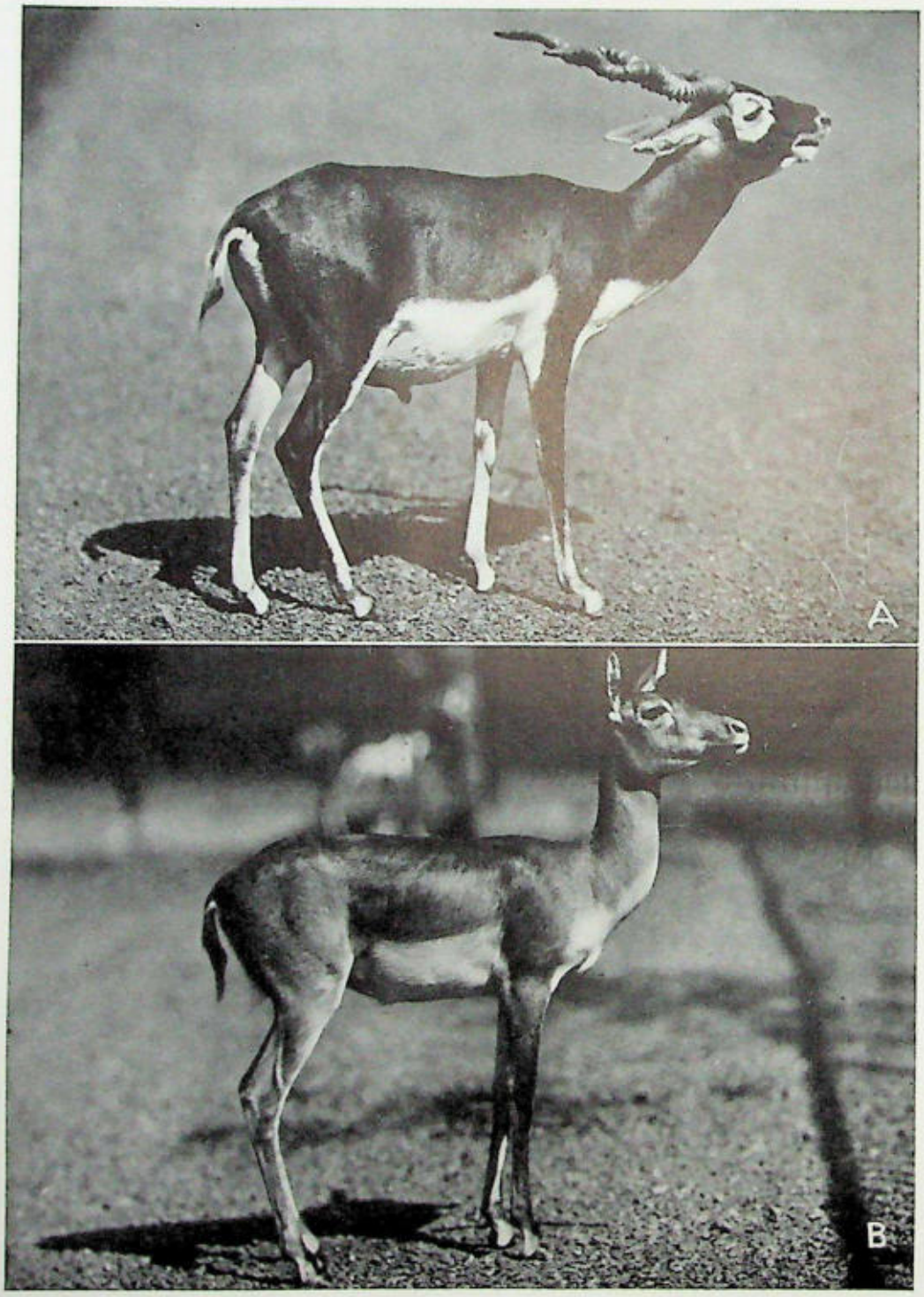


A. Bohor reedbuck. B. The dik-dik (genus *Madoqua*) is one of the very small antelope, standing about 15 inches at the shoulder.
Photographs by Elwin R. Sanborn



A. Male nilgai (*Boselaphus tragocamelus*). B. Female nilgai. The nilgai is the Asiatic representative of the group which is so important in Africa, the Tragelaphinae, and it is also the largest of the Asiatic antelope.

Photographs by Elwin R. Sanborn



A. Male blackbuck (*Antelope cervicapra*). B. Female blackbuck. The blackbuck is probably the best known of the Asiatic antelope. It has a wide distribution in India and is sometimes called the Indian antelope.

Photographs by Elwin R. Sanborn

tern of horn. Among the gazelles the females may or may not be horned, depending on the species, but all of the African gazelles are horned in both sexes. Most of the Asiatic antelope are members of this subfamily which, besides the gazelles, includes the blackbuck of India, the gerenuk and impalla of Africa, and several other peculiar forms of antelope put with the gazelles for want of a better place.

Finally, there are several subfamilies of smaller antelope such as the dik-diks (*Rhynchotraginae*), klipspringers (*Oreotraginae*), oribis (*Nesotraginae*), and duikers (*Cephalophinae*), which the limits of this article require to be given but passing attention. These are, for the most part, small to medium creatures having but tiny horns and not playing much of a part in the sportman's bag or as a trophy. Because of their toy stature, they make very interesting exhibits in zoological parks, however.

Some antelope are often noted as having definite associations with other species of antelope, or with totally unrelated mammals. Gnus, for example, are frequently seen in the company of or near hartebeests and zebras; roan may be in the vicinity of hartebeest, giraffe, or zebra; and waterbuck and kob may be grouped together. Aside from a community of food interests, which will many times bring numbers of different grazing animals into the same region, these antelope evidence a distinct desire for the company of the other species in question.

One species of antelope has become extinct in historical times and others are now facing extinction. The blaaubok, or blue buck, a blue gray relative of the roan antelope, disappeared about 1800, and the bontebok is known today only as a denizen of game reserves. The blesbok is on the brink of disappearance. Other antelope are confined to some special and restricted habitat and are few in number compared to the more generalized and widely ranging species. The giant eland is an example of an antelope which is not very numerous and might disappear in a very short time if its numbers were seriously lowered by an epidemic such as rinderpest.

To be able to find a living in practically every environment and to overcome whatever disadvantage that environment may impose, a group of mammals must be capable of specialization. The greatest number of antelope species is found on the plains and the semi-open stretches where living conditions are such that no especial adaptations other than speed of foot and keenness of scent and vision are needed to successfully maintain the animal. Among such animals are the hartebeest, gnu, and sable.

Some species of oryx and gazelles are able to find sustenance on deserts where they must go weeks and months without water and where it would seem that there was not enough vegetation for even a rabbit.

In the dimly lit forest aisles the bongo and the forest duikers typify the antelope that have left the sun-flooded open grass-lands for the darkness of the trees. The forest types never occur in such numbers as the plains antelopes; the very nature of the environment is against the formation of large herds.

Along large river systems occur great marshy areas, vast stretches of tall grass, papyrus, and water-loving vegetation, an abundance of food for antelope provided they can get it. The situtunga is able to live in these morasses because of its peculiar foot structure, having very long and spreading hooves which bear it up where other animals would break through. The situtunga submerges itself up to the neck when an enemy approaches, and in many ways shows itself to be thoroughly at home in the swamps. The lechwes frequent these same areas and the firmer adjacent ground, having some of the foot specialization of the situtunga and some of the more generalized anatomy of the typical antelopes. The waterbuck finds a congenial home in the grassy stretches along the streams, and while more or less a water-lover is also found at considerable distances from the banks on hard, dry ground.

The brushy thickets form a habitat for another great assemblage of antelope among which are the bushbuck, koodoo, duiker, etc. This type of environment calls for no extreme specialization and in general structure these antelope differ little from the plains animals.

Among the rocky crags and cliffs where footing must be secure, the klipspringer has developed a long, narrow hoof which carries the animal on the extreme tip of the toe and enables it to gain a footing on the slightest irregularity.

This ability of the antelopes to spread out into every ecological niche, to seek and find a food supply regardless of where it exists, has been the chief factor in making them the dominant mammal in Africa today.

In the Zoological Society Bulletin for March-April, 1927, p. 33, Stair's pigeon (*G. stairi*) of the Fiji Islands, is reported as having been bred by Mr. E. W. Gifford, of Oakland, California. Mr. Gifford informs me that this is an error, and that he has not yet succeeded in rearing this beautiful pigeon. The species must therefore be stricken from the "List of Birds Bred in Captivity in the United States." L. S. C.

CATALINA ISLAND WHALING

THE Los Angeles *Examiner* says that, with Los Angeles already a base for widespread whaling activities, a new firm planning to operate exclusively in local waters made its announcement last week.

The concern, financed by San Francisco capital, is the California Sea Products Corporation. A factory tank steamer, the *Lansing*, of 7,500 deadweight tons, and a fleet of four killer ships, has been secured and shortly will begin work. This ship will be manned by a crew of ninety, while the killer ships will be handled by twelve men each.

With South Bay, San Clemente Island, as the immediate base of operations, this will be the first time in more than fifty years that commercial whales will be sought in Southern California waters. Permission to base on the island has been obtained from its owner and from the United States government.

The sea for a radius of from 50 to 100 miles from San Clemente will be combed for blue whales, said to abound in this district. The *Lansing* is now being equipped and fitted out for reducing the giant mammals to an absolute minimum, and preserving their valuable oil and other products—*The Catalina Islander.*

THE VAMPIRE'S BITE

By WILLIAM BEEBE

IT IS astonishing, in these days of wide exploration and keen observation, that any naturalist, such as the one mentioned by Dr. Townsend in the last number of the ZOOLOGICAL SOCIETY BULLETIN, could have made such absurd statements about the bite of vampires. For a quarter of a century I have been interested in and frequently bitten by vampires, and thought that the general facts were known to everyone.

First: Can a vampire bite a human being without awakening him? Answer: Of course it can and in four cases out of five does so.

Second: Does the wound continue to bleed? Answer: Always, if the bat uses his *scoop* method, or has been disturbed. Never, if the *bore* method is used and completed.

I was so impressed by the ability of vampires to make an incision and draw blood without arousing their victim from sleep, that I too, like Townsend's naturalist, tried more than once to equal the skill of this sanguinary flittermouse, and with the finest of needle points to draw a drop of blood from the finger of a sound sleeping member of my staff. It was an absolute failure, as the man awoke at the very first touch of the needle. Yet the night before, he had twice been bitten, the first wound bleeding freely, as his restlessness had interrupted the operation, the second hardly detectable, showing a deep hollow, sealed by some astringent liquid, perhaps saliva, which the bat must have applied.

On looking through some of my earlier published books, I find frequent mention of vampires, among which are the following:

Twenty-three years ago in far western Mexico, I wrote,[1] "Indoors our cots kept us out of trouble, but a vampire annoyed us for an hour or two, fluttering close to our heads and making sleep impossible. The horses next morning showed evidence of visits from these blood-thirsty bats—long streaks of blood on their necks and shoulders."

Five years later and nearly three thousand miles away, far up a river in British Guiana, I noted that[2] "Vampires are so abundant at Matope that every evening one of the servants collects the chair cushions on the veranda and packs them under an upturned chair. Otherwise the dogs, bitten while sleeping on these cushions, would ruin them with their blood."

And again, "The blacks in this part of the country call the vampires 'Dr. Blairs,' after a certain colonial doctor of the olden times whose favorite method of treatment was blood-letting."

The Rev. Walter G. White contributed a chapter to my "Tropical Wild Life" and on page 468 writes as follows of the vampires in the hinterland of Guiana:

"The dogs kept by the Indians lose nearly all their pups, owing to the attacks of vampires. The mothers know how to roll over and to brush off the horrid creature; but they are helpless to save their pups. Our pet would run backwards and forwards, from her yelling pups to our bedroom door, whining for us to come and remove the attacking horror. Fowls must be carefully protected at night in wire-net houses. Calves suffered severely. They became emaciated, and some of them succumbed, ere they could grow to be large enough to withstand the continual lancing. In 1902 I was attacked by a vampire, during sleep. I knew nothing of it until the morning, when my attention was called to a large patch of blood upon my hammock. Examination of my feet showed a round hole about three-eighths of an inch in diameter and one-eighth deep, in one of my big toes. The edge was regular."

[1] "Two Bird-Lovers in Mexico," p. 268.
[2] "Our Search for a Wilderness," p. 258.

I have been bitten on the toes, fingers, elbow and once on the cheek, and on only two occasions did I waken and thereby lose more blood than could be contained in the thimble-sized stomach of my assailant. The bites of vampires are of two kinds, which I have always differentiated as the *scoop* and the *bore*. The former is obviously done by an oblique cut, either swift or slow abrasion, of the incisors. It is superficial and is more often found on animals such as mules and fowls. It always bleeds freely. The bore is wholly mysterious as to execution and may or may not bleed. If the bat is driven away by the actual awakening or the unconscious restlessness of its victim, a small amount of blood flows from the tiny round hole. If the bat completes its operation, not a drop of blood is lost and no infection results. The wound is filled with a plug of soft, greyish matter, almost wax-like. The exact method of boring; the reason why the sleeper seldom wakens; and the source and nature of the antiseptic plug will furnish one of the most interesting discoveries in cheiropterygian ecology.

I have made every effort to observe a vampire at work, but it is a most difficult matter, for the dimmest of lights will keep them away. My last effort, at Kartabo, I narrated in "Edge of the Jungle," page eighteen *et seq*:

"In the evening great bats as large as small herons swept down the long front gallery where we worked, gleaning as they went; but the vampires were long in coming, and for months we neither saw nor heard of one. Then they attacked our servants, and we took heart, and night after night exposed our toes, as conventionally accepted vampire-bait. When at last they found that the color of our skins was no criterion of dilution of blood, they came in crowds. For three nights they swept about us with hardly a whisper of wings, and accepted either toe or elbow or finger or all three, and the cots and floor in the morning looked like an emergency hospital behind an active front. In spite of every attempt at keeping awake, we dropped off to sleep before the bats had begun, and did not awaken until they left. We ascertained, however, that there was no truth in the belief that they hovered or kept fanning with their wings. Instead, they settled on the person with an appreciable flop and then crawled to the desired spot.

"One night I made a special effort and, with bared arm, prepared for a long vigil. In a few minutes bats began to fan my face, the wings almost brushing, but never quite touching my skin. I could distinguish the difference between the smaller and the larger, the latter having a deeper swish, deeper and longer drawn out. Their voices were so high and shrill that the singing of the jungle crickets seemed almost contralto in comparison. Finally, I began to feel myself the focus of one or more of these winged weasels. The swishes became more frequent, the returnings almost doubling on their track. Now and then a small body touched the sheet for an instant, and then, with a soft little tap, a vampire alighted on my chest. I was half sitting up, yet I could not see him, for I had found that the least hint of light ended any possibility of a visit. I breathed as quietly as I could, and made sure that both hands were clear. For a long time there was no movement, and the renewed swishes made me suspect that the bat had again taken flight. Not until I felt a tickling on my wrist did I know that my visitor had shifted and, unerringly, was making for the arm which I had exposed. Slowly it crept forward, but I hardly felt the pushing of the feet and pulling of the thumbs as it crawled along. If I had been asleep, I should not have awakened. It continued up my forearm and came to rest at my elbow. Here another long period of rest, and then several short, quick shifts of body. With my whole attention concentrated on my elbow, I began to imagine various sensations as my mind pictured the long, lancet tooth sinking deep into the skin, and the blood pumping up. I even began to feel the hot rush of my vital fluid over my arm, and then found that I had dozed for a moment and that all my sensations were imaginary. But soon a gentle tickling became apparent, and, in spite of putting this out of my mind and with increasing doubts as to the bat being still there, the tickling continued. It changed to a tingling, rather pleasant than otherwise, like the first stage of having one's hand asleep.

"It really seemed as if this were the critical time. Somehow or other the vampire was at work with no pain or even inconvenience to me, and now was the moment to seize him, call for a lantern, and solve his supersurgical skill—the exact method of this vespertilial anaesthetist. Slowly, very slowly, I lifted the other hand, always thinking of my elbow, so that I might keep all the muscles relaxed. Very slowly it approached, and with as swift a motion as I could achieve, I grasped at the vampire. I felt a touch of fur and I gripped a struggling, skinny wing; there came a single nip of teeth, and the wing-tip slipped through my fingers. I could detect no trace of blood by feeling, so turned over and went to sleep. In the morning

I found a tiny scratch, with the skin barely broken; and, heartily disappointed, I realized that my tickling and tingling had been the preliminary symptoms of the operation."

In the study of this and all similar phenomena, the first-hand, pragmatic method is the one most worth quoting. Less than four hundred years ago Oxford decreed that "Masters and Bachelors who did not follow Aristotle faithfully were liable to a fine of five shillings for every point of divergence, and for every fault committed against the logic of the Organon." Today, whether we are testing the ancient myths of the Sargasso Sea, the belief that every shark is a man-eater, or the Hows and Whys of a vampire's bite, we should strive to supplement the statements of early writers with renewed proof; we should go out and solve for ourselves, these and a thousand other joyous questions.

THE SECRET OF THE SWALLOW-WINGED PUFF-BIRD

By GLORIA HOLLISTER *and* WILLIAM BEEBE

Photographs by Gloria Hollister

LATE one afternoon in early April we tramped along the edge of the sombre jungle near Rockstone, British Guiana, returning from an obsolete, overgrown Indian trail where we had collected many specimens of bugs and butterflies. The atmosphere was unusually gray and saturated with choking smoke from smoldering bush fires up country. The silence was marred only by the rhythmic rustling of parched grass and the snapping of dried twigs underfoot. This monotony was broken by occasional shrieks from small flocks of parrots returning from their feeding haunts and the swooping flight of several somber-colored birds. Our native guide told us with unconcern that these were "Fly-Hawks" and were very common. We noticed several solitary individuals perching on the dead limbs of a tall tree. We dropped down near this giant Mora tree to watch the fading of a tropical day. Suddenly, the dark form of a "Fly-Hawk" was silhouetted against a sand bank only a few feet in front of us. It vanished just as suddenly and because of the semi-darkness we could not follow its flight.

We had resumed our campward tramp by obscure moonlight when a dark object moved on the sand bank but disappeared before we could approach near enough to identify it. There was a small hole near where we had seen this moving object but it was too dark to discover footprints. Our black boy said that this hole was probably the home of some reptile. Just for the thrill of finding the unknown I anchored my net over the hole and, with the detached end, began to poke blindly. Perhaps a four-legged hopping creature, or perhaps a wriggling limbless reptile would emerge! After several minutes I felt active resistance and before I could withdraw the stick a fluttering, bewildered bird was in my net.

We carried this little fellow back to camp and by the aid of a flickering tallow light recognized a "Fly-Hawk." My interest now was keenly aroused. The idea of a hawk found in a sand bank was extremely novel. We had before us a chunky, medium-sized bird of a dull metallic blue with rufous belly; white rump, sides and under wings. It had a very short square tail, long swallow-like wings, and a straight, compressed black bill. The face was a bluish slate black, the legs a purplish black, and the feet a true black. Several times this bird puffed out its head feathers to almost a perfect sphere, which gave it the appearance of a grotesque puff-ball. All this was sufficient to associate this bird not with the Hawk family, but with the Puff-birds. The extremely long swallow-like wings identified it as the Swallow-winged Puff-bird, *Chelidoptera tenebrosa*.

That night I began to wonder about the hole in the sand bank and wished for the morning light. Why was this bird in the hole? Was this just a temporary haven to escape from some larger creature, or was it instinct to occupy such holes at night? We had seen these birds in tall trees only, and the feet of our specimen seemed little adapted to any type of ground life.

Early the next morning, before the night had given way to another day, we were tramping again along the edge of the jungle toward the Mora tree and the questioned hole in the sand bank. It was still dark when we reached there so we hid in a secluded spot from where we could observe the Mora tree and the full extent of the bank. At the coming of day the enveloping shrouds fled from the jungle giants and a multitude of sounds filled the forest. In the distance a band of red howling monkeys was discussing their affairs in roaring, booming howls; the mighty roar of a lion seemed weak

The swallow-winged puff-bird. 1. *Chelidoptera tenebrosa*: 2. *Chelidoptera brasiliensis*. From a photograph made by the American Museum Natural History in Selater's Monograph of the Jacamars and Puff-birds.

by comparison. Several flocks of parrots screeched their way toward the morning feeding haunts and a tapir browsed toward the river. Three Puff-birds suddenly appeared from the direction of the jungle and lighted on the dead tips of the tallest limbs of a large tree nearby. Here they remained nearly motionless, puffing out their head feathers at intervals. One swooped low after a flying insect and returned to its place on the dead limb. Just then a round black head appeared in the sand bank and after gazing about and repeatedly puffing up its feathers with a complaisant air, it darted away toward the jungle. Several more swallow-wings came from the forest. Two joined the first three still perching in the big tree while one scurried into a distant hole with a piece of dried grass. In a few minutes two birds dropped with undulating flight from the tree, and started to scratch in the sand with great vigour. Several times the bird from the most distant hole made excursions to the edge of the forest for dried grass. This activity kept up until the heat of the tropical day began to descend upon us. Then, as if at a given signal, all these Puff-birds darted off into the cool, dense growth of the jungle. This was our chance for closer observation of the holes. With keen interest we started to clear away the sand from the hole which our captive bird had occupied. The diameter of the opening was slightly larger than that of my pedometer and situated about two and one-half feet below the surface of the bank. A tunnel extended horizontally into the bank for almost three feet. The last half-foot was hollowed out several inches wider and higher. Here on a sparse, loose nest of dried grass were two milk-white eggs. We had found the nest and eggs of the Swallow-winged Puff-birds! The other nest contained but one egg and two other holes were in different stages of excavation.

In the middle of April (the eighteenth) a nest was found with two nestlings. The larger

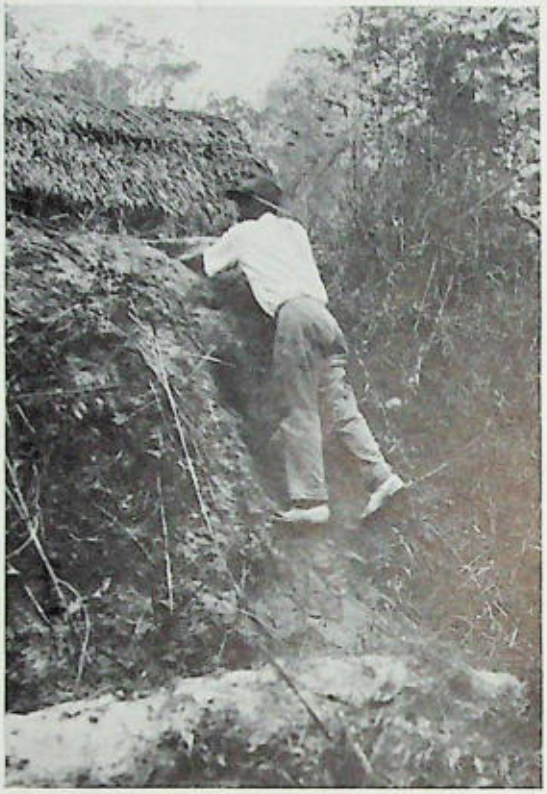
A sharp bend in the Essequibo River near Racerock. The impenetrable jungle grows to the water's edge.

of the two was jet black all over, with dull livid abdomen; remarkably steady on its feet, resting on the entire tarsus, with even the large abdomen clear of the ground, or after a long walk occasionally steadying itself with it; all four toes pointing forward. It progressed by rapid, scuttling steps, with equal facility forward or backward. The latter was by far the favorite direction. When placed on the table, with its head toward the light, it backed over paper, lenses, instruments, vials and all sorts of obstacles to the end farthest from the light. When placed tail toward the light, it started off forwards, but soon swung round to one side, and then went into reverse, and backed the rest of the way; given a box, it crept at once into a corner facing out and was happy.

Its eyes were only slightly open; and it was very susceptible to sounds, jumping at a whistle, chirp, or the sound of the camera shutter. When warmed in the hand it uttered an almost inaudible *sweet! sweet! sweet!* When suddenly alarmed, this increased to a series of shrill, loud notes, very like those of the adult. There is no reaching up in a prolonged gape for food, but now and then the bird apparently yawns for about a second, not stretching up the neck. Another favorite habit was a rapid flapping or quivering of the dangling or half outheld wings. They recalled both penguins and toucans.

The flights showed as short, thick, strongly recurved hooks like those of parrots. The

Along the edge of the jungle on the Essequibo river near Racerock.



Digging out the nest; the figure shows the height of the sand bank.

interior of the mouth and the tongue were pale flesh color; egg tooth very small; oil gland very prominent, slender, finger-like.

The food consisted of small beetles, flies, weevils, winged wasps, ants, grasshoppers and bees.

In Sclater's Monograph of the Jacamars and and Puff-birds (1879-1882) we read in his discussion of "Habits and Distribution of the Puff-birds": "Very little has as yet been written of the life and habits of the Puff-birds. Speaking generally it may be said that the Puff-birds are a purely arboreal and forest frequenting group. They seem to pass the greater parts of their lives sitting upon the topmost or outermost branches of the trees, generally selecting twigs that are dry and withered for their perch, and looking out for insects, which are captured flying, and constitute their only food.

"The Swallow-wing (*Chelidoptera*) nests in holes in banks, like the kingfishers, and lays white eggs. Of the mode of nidification of the otter species of the family we are at present almost entirely ignorant; but it is probable that they either follow the same practice or else nest in hollow trees, and that their eggs are colorless, like those of other birds which deposit their eggs in similar situations.

"As with the Jacamars so with the Puff-birds, the stronghold of the group is the great forest-region of Amazonia.

North and South of what may be termed their 'focus' these birds rapidly fall off in number of species, until in Guatemala we meet with but two and in Paraguay but one of these birds."

"The 'Smaller Swallow-wing' (as I propose to call this bird in English) although not included by Linnaeus in the latest edition of the *Systema Naturae*, was made known to us shortly after publication of that work in the writing of Buffon and Pallas. Both these naturalists, as well as Latham and Guelin, considered our species a Cuckoo; but in 1806 it was correctly transferred by Le Vaillaut to the family to which it undoubtedly belongs. The older writers received their specimens of this species from Cayenne and Surinam. Temminck, who figured it in 1825 as 'Monasa tenebrio,' says that it is found in every part of Guiana. Schomburgk, speaking of British Guiana, says that *although the bird is so common he could never find its nest*. 'It sits high, and usually on the outer branches of the trees.'

"From Guiana the present bird extends into Venezuela and over nearly every part of Amazonia that has been visited by naturalists. Goering obtained it to the southeast of Merida in Venezuela, Wallace at Para and on the Rio

Location of the nest with a pedometer illustrating the relative size of the opening.

Fledgling puff-birds found in a nest. The larger was jet black and very steady on its feet.

Negro, 'abundant' in both localities, and Bartlett, Whitely, and Hauxwell at various stations on the rivers of the Upper Amazonia.

There is record of nesting conditions in British Guiana, of only one other species of Puff-bird. Mr. C. A. Lloyd, writing on the nesting of some Guiana birds, remarks: "According to Mr. Barshall the burrows of the Armadillo and Paca are resorted to by the Black Puff-bird or *Monasa niger*, as a nesting place. He has never seen their eggs, but all the nests examined by him have contained two young birds.

Neither in Sclater's "Monograph" nor in Chubb's extensive work "Birds of British Guiana" is there any record of the nesting habits of the Swallow-winged Puff-bird in British Guiana or any photographic record of the nest, eggs and the nestlings.

THE MYSTERY OF MIGRATION*

By Lee S. Crandall

Curator of Birds, Zoological Park

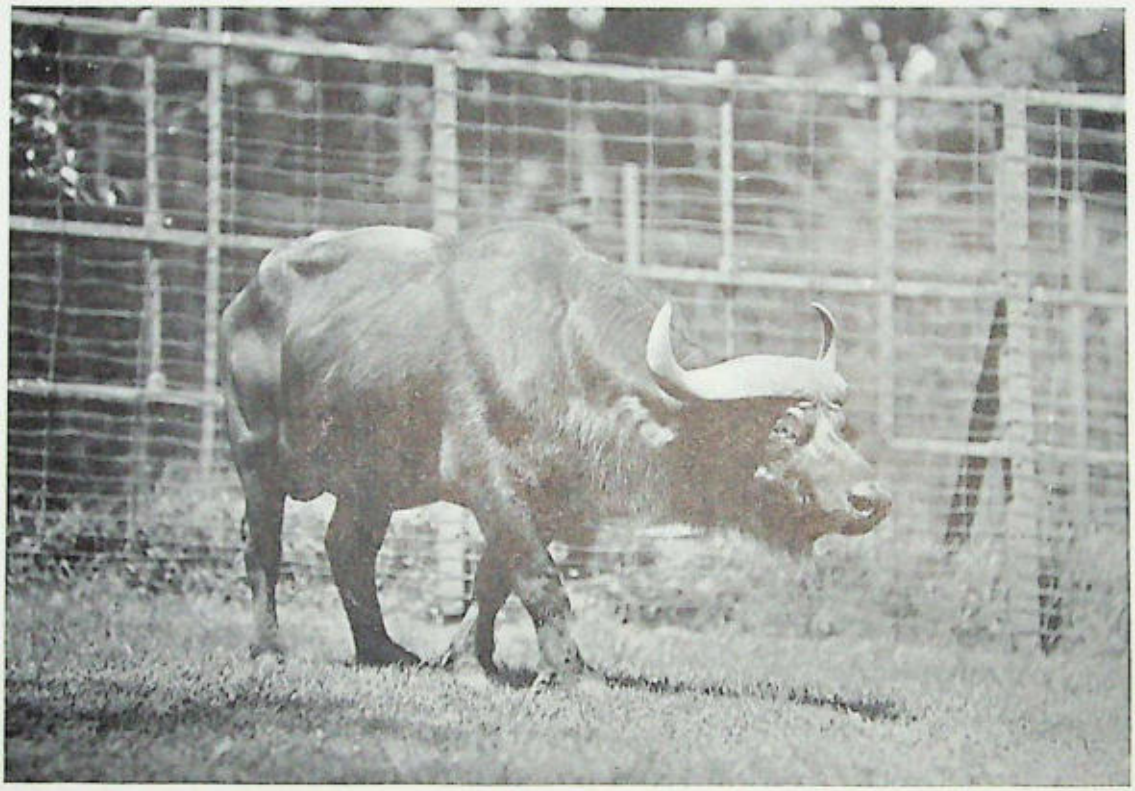
THE remarkable mass movements of many species of birds, southward in autumn and northward in spring, have aroused the interest and curiosity of men from the very earliest times. The honking of migrating geese, the soft calls of travellers through the skies in the depth of night, are among the most romantic and provocative sounds in nature. Yet the continued efforts of naturalists and philosophers, through the ages, to solve the basic problems of this phenomenon have brought us but little nearer to a final solution.

In "Problems of Bird Migration" Dr. A. Landsborough Thomson brings together the most important facts that have so far been gleaned, outlines the best of the work at present under way and sums up the phases of the problem that are as yet unsolved. Dr. Thomson is the son of Professor J. Arthur Thomson, and is himself a specialist in animal behavior, so that he approaches the subject from a broader point of view than the ornithologist is able to bring to bear.

The work is divided into three sections, the first being devoted to general consideration of the known facts. Here we learn that migration is not at all confined to birds but is manifested by many groups, from Crustacea to Mam-

The nest after excavation showing an egg lying at the bottom.

* PROBLEMS OF BIRD MIGRATION. By A. Landsborough Thomson. Pp. 350 + XIV. Houghton Mifflin Co., Boston and New York, 1926. $5.00



Cape Buffalo (*Bos cafer*)) presented to the Zoological Park by the Junior Auxiliary of the Society.
Photograph by F. D. Crosby

mals. The behavior of migrating birds, migration lines and routes of flight, and similar phases, are carefully considered.

Part II contains a mass of data concerning European species, acquired by means of bird-banding, the newest and probably the most important movement in migration study. Young birds, or trapped adults, are marked by means of light aluminum rings, placed on the leg. These bands bear serial numbers and the marker's address. When the wearer of a ring comes to grief or possibly enters the trap of another bander, it is hoped that the record will be sent to the original marker. While the majority are never again heard from, of course, a great and increasing number of returns are actually made. In this manner, definite records are obtainable concerning the movements of species. Bird-banding has not yet reached its pinnacle but there seems to be no doubt that it will eventually prove of the greatest possible value.

The final section sums up the dominant problems, which Dr. Thomson considers to be four in number: the purpose of migration, the origin of the custom, the activating stimuli and the mysterious means by which long flights are accomplished. In outlining these points, Dr. Thomson says:

"Bird-migration, then, is the expression of an inborn custom—an example of behaviour for which the capacity is inherited. It is an expensive custom and would not survive did it not serve some useful ends; the advantages of the custom, however, are in part obvious. But that useful ends are served by it does not explain the existence of migration: the presence of advantages is not in itself a causative force. The ultimate cause and origin of the racial custom must be sought in the past history of migratory species. Immediate factors, in addition to the existence of the inherited tendency, must also act as recurrent stimuli, bringing the custom into play in the individual at the proper times. Granted a useful end, an originating cause and a releasing stimulus, the *modus operandi* of migration still remains unexplained."

"Problems of Bird Migration" is a clear and full statement of what is known and what remains to be learned in this remarkable phase of bird life. As a starting point for workers in this field, it will long continue to function.

New York Zoological Society

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THREE COLOR PHASES OF (*Echeneis naucrates*) THE SHARK-SUCKER

Painted from life in the New York Aquarium by Olive Earle.

THIS IS THE FIRST OF A SERIES OF PAINTINGS ILLUSTRATIVE OF INSTANTANEOUS CHANGES IN COLOR AMONG FISHES, WHICH WILL APPEAR REGULARLY IN THE BULLETIN OF THE ZOOLOGICAL SOCIETY. THEY ARE TAKEN FROM A WORK ON THIS SUBJECT BY DR. CHARLES H. TOWNSEND, NOW BEING PUBLISHED UNDER THE AUSPICES OF THE NEW YORK ZOOLOGICAL SOCIETY.

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RECORDS OF COLOR CHANGES AMONG FISHES

1. Three Color Changes of the Shark-Sucker (*Echeneis naucrates*)

By CHARLES H. TOWNSEND

THERE are several species of fishes of the family Echeneididae which are widely known by the name "shark-sucker". Such fishes habitually cling to the bodies of sharks by means of an air disk on top of the head. One of these, *Echeneis naucrates*, has for many years been exhibited at the New York Aquarium, where one or more individuals may be seen clinging to a shark or swimming close beside it. Like most of the showy tropical fishes kept in the Aquarium, it has the power to change color instantaneously. Three of its phases of coloration are shown in the accompanying reproduction of a painting made in the Aquarium by Olive Earle.

The shark-sucker has the risky honor of serving as "orderly" to the shark. While enjoying his customary free transportation he often changes his uniform of black with white stripes to one of gray or even of jet black. While clinging to or swimming close beside the shark, the darker costumes are usually worn. When kept in a tank by itself it often clings to the glass front and becomes uniformly gray. It may even assume a position on the bottom of the tank, turning over and applying the sucking disk on the top of its head to the concrete floor, so strong is the inclination to make fast to something. Such positions are, however, unnatural. In company with a shark, porpoise or sea turtle it promptly makes fast and refuses to be dislodged. We have seen shark-suckers clinging firmly to porpoises that were racing under the bow of a fast moving steamer. The color changes practiced by this fish are usually made instantaneously. Those shown here are the ones usually displayed, but frequently when the upper surface and the black stripe along the side remain black, the fish may turn entirely white beneath.

As observations made in the Aquarium have shown that most tropical fishes have several different colorations ready for instant use, it is evident that paintings representing but one of the several colorations possible, are of comparatively little scientific value. The artist afloat painting a captive fish in a small portable aquarium, gets only the colors and markings displayed when the fish is alarmed or distressed. Its more normal colorations, of which there may be as many as eight, remain unobserved. The records of the changes made by fishes in the New York Aquarium, were completed only after observations extending over several weeks.

A painting of a freshly killed specimen shows none of the color phases of the living fish. Its color cells are relaxed at death and real life colors can no longer be recorded no matter how rapidly the artist may work. Most ichthyological works are marred by colored plates of this character. A zoologically correct drawing of a preserved fish is preferable, unless the object is merely a picture.

The exhibit of a shark accompanied by shark-suckers has been maintained at the Aquarium for several years. In summer shark-suckers often accompany sharks into the lower part of New York Bay, where both species were captured. During the past summer the Aquarium boat brought from the vicinity of Sandy Hook the seven sand sharks now on exhibition. The late Professor Bateson of Cambridge University declared that our shark and shark-sucker together, constituted "the best aquarium exhibit ever attempted".

It is the destiny of the shark to tow perpetually through the seas this fish loafer, foreordained to be a hanger-on since the beginning of fish time.

THE AMPHIBIANS*

Illustrations from photographs by Elwin R. Sanborn, Leonard B. Spencer, L. L. Mowbray, American Museum of Natural History and works on Amphibians.

By Ida Mellen

"AMPHIBIAN" is a comparatively modern word, not to be found in dictionaries of a hundred years ago; yet it should be used more commonly, because, when such a word was needed in modern zoological classifications, it grew naturally out of an already existing word —"amphibious." ("Amphibious, *a.*, that can live in two elements." "Frog, *s.*, an amphibious animal."—Early nineteenth century definitions.)

The classifications themselves have changed radically, for a reptile was "an animal that creeps upon many feet," and this included the scorpions; an oyster was "a bivalve, testaceous fish;" a whale was "the largest of fish;" and various other forms now grouped as mammals, such as seals and human beings, were called amphibious animals because they could live on land and also in the water. The word "mammal" came later.

Amphibians, in the careful, present-day classifications, comprise our familiar friends, the frogs and toads, the less known salamanders, and the little known caecilians. Frogs and toads, all tailless in the adult form, normally have four legs. (A frog with five legs was exhibited at the New York Aquarium during 1927.) Most of the salamanders have four legs, though some go through life with only two. The caecilians are legless and look more like snakes or earthworms than relatives of salamanders and frogs, some of them being scaled and others scaleless.

Most of the amphibians, true to their name, live indifferently in water or on land. Their embryonic development is the chief characteristic of the group, the majority undergoing that metamorphosis with which we are so well acquainted in the frogs; hatching in the water with fish-like bodies and external gills, losing the external gills to develop internal ones, finally exchanging these for lungs, growing legs and leaving their aquatic abode for a terrestrial one; but many continue to feed in the water or to return to it to breed and to hibernate. Amphibians which lay hundreds of eggs, generally leave them to their fate; but some, which do not lay as many, take good care of them.

Since we know the general rules governing the development and habits of the group, it may be interesting first to hear about some very strange exceptions, and then to hear more particulars about some of the species we are likely to meet.

The Alpine salamander (*Salamandra atra*), which lives at the roots of the Alpine rose, is, for example, one of the rare species that bring forth their young alive, and there are but two at a birth. The common American mud puppy retains its external gills through life, and the Mexican axolotl or tiger salamander (*Ambystoma tigrinum*), occasionally exhibited at the New York Aquarium, breeds in the larval stage and yet is known to develop lungs, either voluntarily or in emergencies, as when its watery home dries up. Singular to relate, the animal can be induced to metamorphose if fed with thyroid or pituitary gland. The female of another American salamander, the mud "eel," or Congo "eel," (*Amphiuma means*) incubates her eggs by coiling about them, and some of the snake-like caecilians or "blind worms" of tropical America, Ceylon and Siam, incubate their eggs in the same way, while others bring forth their young alive. The caecilians exchange their gills for lungs, but if born with good eyes they lose the use of them later and, as already mentioned, never acquire legs.

Among frogs and toads, all of which differ from the salamanders and caecilians in that their tails are absorbed into the body when they develop their legs, there are no less remarkable exceptions. In Peru, a species of tree frog is found which carries its eggs in a pouch on the back and they hatch out tadpoles; whereas a West Indian tree frog hides its eggs under stones or fastens them to the leaves of trees, and they hatch out perfect little frogs. The story of the obstetric or midwife toad of Europe (*Alytes obstetricans*) is an example of how much stranger truth is than fiction. In this species, the male steps through the fresh egg-masses, and as they are rather sticky, they adhere to his hind legs, forming a festoon. Being by nature acquisitive as well as polygamous, he often seeks a second mate and adds to his collection still another festoon. He carries his treasures about for three weeks, when they are ready

* We have not attempted here to make a perfect zoological classification, but rather to depict representative forms, and acquaint the reader with the group of frogs, toads and salamanders.—Editor.

The Mud Puppy—a salamander common in our northeastern states and nearly always on exhibition at the New York Aquarium, where this photograph was taken.

The Mud Puppy's external gills never give place to lungs. Each foot has four toes, and the tail, as its shape indicates, is used as a paddle in swimming.

to hatch. Then that something which we evasively call "instinct" because we cannot explain it, urges him to betake himself to the water. An animal never disobeys its instincts even if they are wrong. As most often happens, the instinct in this case is right and his return to the water enables the young on issuing from the eggs to swim in their natural element, there to live and grow and mature, and eventually to follow—without instruction, and again we say "by instinct"—the singular breeding habits of their parents.

The male of a South American frog (*Rhinoderma darwini*), a species only an inch long, transfers the eggs to his immense vocal sacs for incubation. The habits of the Surinam toad—called *Rana americana* because a native of the Guianas—often have been described and pictured. It is a peculiar animal, with flat, triangular head, large hind legs bearing strongly webbed feet, and slender front legs with long, delicate fingers that end in star-shaped tips. The male toad directs the oviduct of the female to her back and presses out the adhesive eggs. Her back, in the breeding season, becomes soft and resistant as a feather bed, and the delicate eggs sink into the epidermis, where they are soon enclosed in a cup of soft skin with a lid to protect them from the air. Embryos with large yolk sacs have been taken from the pits in the backs of these toads, but normal development is concluded in the pits and when the young break through the lids, little legs may be seen protruding in all directions, and perfect little Surinams hop out.

The horned tree frog of Ecuador lays but a few large eggs (less than a dozen) which are carried openly on the back of the mother. She is called a marsupial frog because the young draw nourishment through her skin by means of cup-shaped gills which grow out of their throats on long, slender stalks.

Other species, such as the smooth-clawed frogs of Africa and frogs of the Andes, are wholly aquatic, and instead of breathing with lungs, respire through the skin. Still others live entirely on land.

They seem to grow more and more curious as we go on; but let us get better acquainted now with the salamanders. Eighteen different kinds have been shown at the New York Aquarium from time to time, including Asiatic salamanders, Shasta and other salamanders of California, the common newt and blind proteus of Europe, the marbled, spotted, red, slimy and gray salamanders, the Congo eel, siren and others.

All the salamanders have not been classified, but 102 species are known and named, and 66 of these—that is, more than half—inhabit the Americas. In the confines of the present paper we shall be able to describe but a few representative kinds.

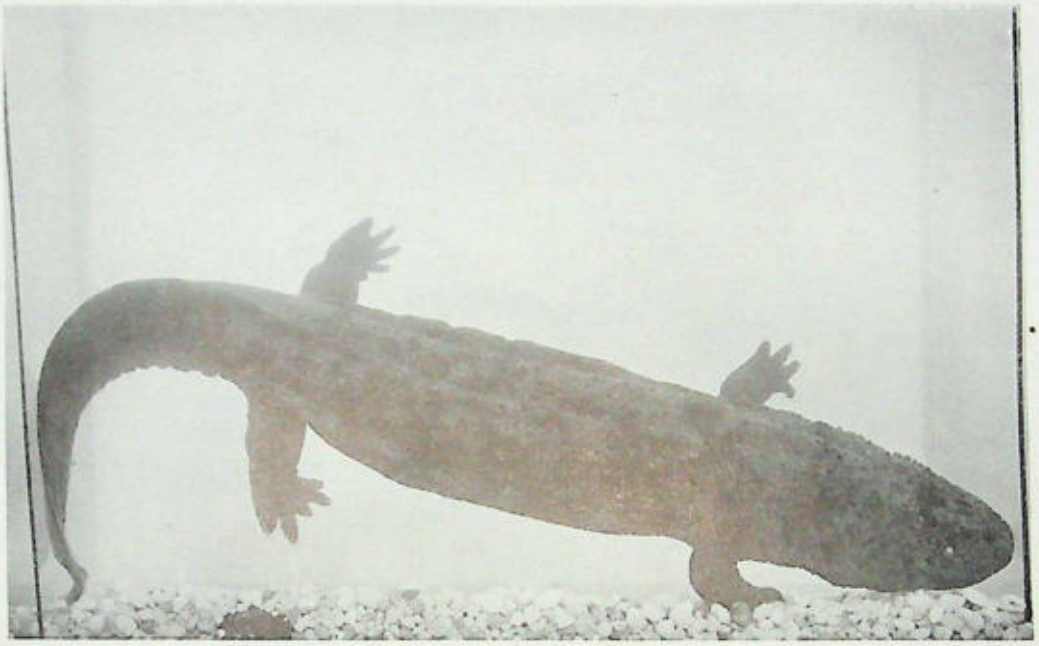
The two most conspicuous United States species are the mud puppy (*Necturus maculosus*) of the Ohio, Mississippi and Hudson rivers, Lake Champlain and the Great Lakes tributaries, and the hellbender or water-dog (*Cryptobranchus alleganiensis*) of somewhat similar distribution. Both are on almost constant exhibition at the Aquarium. They never leave the water and, like many other amphibians, are largely nocturnal. Food thrown into the tanks during the day, sometimes is not taken up until nightfall. The mud puppy, with a maximum length of about one foot, is slimy, difficult to handle, and does not exhibit much intelligence; but to the lover of beauty it is a truly beautiful creature, with grayish-brown body faintly spotted with black, and most exquisite maroon-colored external gills which, as the animal breathes, wave in the water like dyed ostrich plumes. Those who have studied its habits say that it mates in the fall but the eggs are not laid until spring. A nest is made on large stones in water from three to five feet deep, some fifty or one hundred feet from the shore, and is guarded by the female. The eggs, numbering about seventy, hatch early in July, and the young mud puppies are yellow. At one year they measure three inches in length and, like the adults, prey on leeches and insect larvae, fishes, frogs and crayfishes. The mud puppy sometimes is condemned as an enemy of fishes because of its destructiveness to the eggs and young of food species such as whitefishes.

Hellbenders, with their speckled, dull brown wrinkled skin, and awkward movements, are not to be admired for beauty or grace, but are interesting in point of size and relationship. With a maximum length of two feet, they appear to be in various ways—noticeably in the shape of head and body—the nearest relative of the giant salamander of Japan, like which they thrive in cool, shallow, running water. They retain their gill slits but develop lungs and rise to the surface for air, apparently never being tempted to leave their watery home. For food, they seek the succulent crayfish, with an occasional juicy worm or small fish, and are much hated by fishermen, whose bait they greedily take.

Some salamanders are long lived, the giant Japanese species (*Megalobatrachus japonicus*), called by the Japanese "sanshō-uo," having a

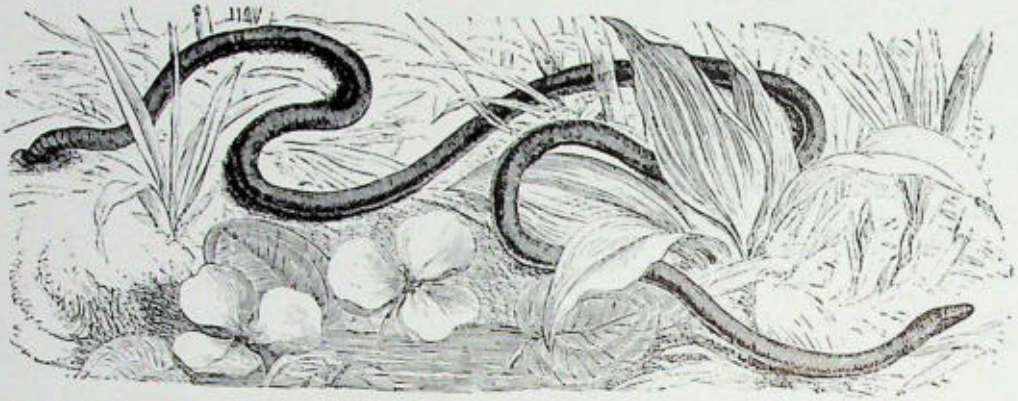
The Hellbender or Water-dog of our northeastern states, attaining to a length of two feet, is a near relative of the giant salamander of Japan. By day it is sluggish, like many other water-inhabiting animals, and does its foraging largely by night, when it is as active as its dull nature permits. It feeds almost exclusively on crayfishes.

Upper photograph by Leonard B. Spencer

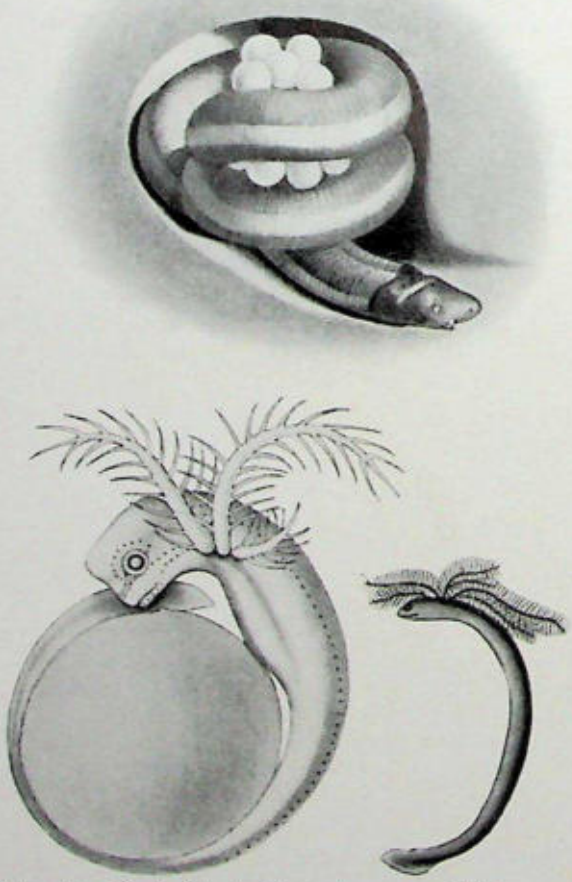


The world's largest salamander is the Sanshō-uo of Japan, which reaches a length of five feet and is believed to live for more than a century. It inhabits the shallow streams of high mountains.

Aneides, white but not an albino, delicately textured and interestingly constructed, is one of the Califo nia salamanders seldom seen in the eastern states. The specimen shown lived for a time at the Zoological Park.



The Caecilian belongs to a rare tropical family of salamanders that are legless and frequently blind, and resemble snakes and burrowing earthworms. They have no tail, the anus being located at the end of the body. From The Standard Natural History.



Some Caecilians incubate their eggs by coiling the body about them. In one genus (*Epicrium*) the embryo lies coiled like a fish over its yolk sac, but the branched external gills betray it as a member of the salamander tribe. These animals live in holes in damp earth and feed on grubs and other insect larvae. From Reptiles, Amphibians and Fishes, edited by J. H. Cunningham.

particularly remarkable record of longevity in captivity and small quarters. In the New York Aquarium a specimen recently died that had been in the institution for nineteen years, and the first one to reach the Occident lived in England for fifty-two years. The species actually bred in the tanks of the Amsterdam Aquarium in a water temperature not above 68° and in a tank 6′ x 6′ x 4′ deep, which approximated the limited quarters these animals take up in the shallow narrow beds of the cold mountain streams of Japan. The male, according to Dr. C. Kerbert, late Director of the Amsterdam Aquarium, guards the nest, driving off the female. The eggs hatch in about two months, and the young pass a long time in the larval stage. (For further particulars concerning this rare species, see the BULLETIN for May-June, 1927, which contains a translation of an article on the subject by Dr. Kerbert.)

A recent item in the *Ateo Fisheries News* states that a specimen of the giant Japanese salamander believed to be nearly 150 years old, which had lived for more than 130 years in a pond on the grounds of a temple near Asakura, Japan, was lately presented to the Prince Regent by the head priest of the temple. This will make a valuable addition to longevity statistics if the figures can be verified.

These great salamanders, five feet in length, are but small, present-day representatives of the giants of prehistoric times, such as the labyrinthodonts, among which figured the armored Mastodonsaurus, a European and Asiatic species with a skull measuring three feet in length. The finding of more than thirty species of labyrinthodonts in Ohio coal deposits gives us an idea of the enormous number and size of the salamanders that once roamed this section of the earth, and makes us regret that no human eye ever will see their like.

All three of the large extant species particularly described—the American mud puppy and hellbender and the Japanese giant salamander—and also the smaller Mexican axolotl, have some economic value, being used more or less for food. None, however, ranks as high gastronomically as the frogs, and none is as good a friend to man as the common toad.

There is always a bit of irony in our human designations of wild animals as our friends and enemies. It is customary to regard as our friends such wild creatures as happen by nature to prey upon animals we have found "useless" or destructive, and to regard as our enemies those that by nature are fond of the same things to eat that we are. Thus the toad, in its insect-devouring capacity, becomes our friend, and the starfish, because it likes oysters and clams as much as we do, is our enemy. The "useless" animals are those that render us no service and that we have found no excuse for preying upon.

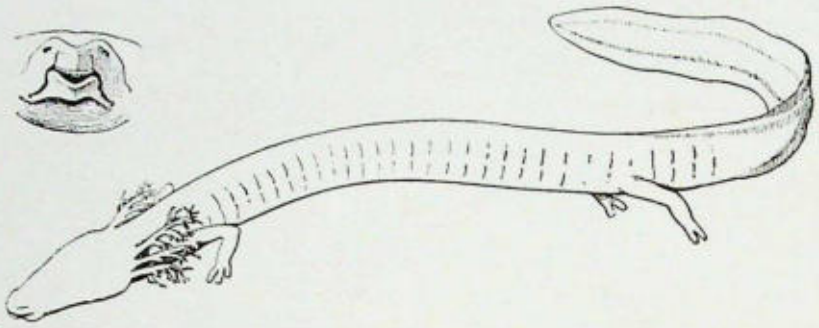
In the same family with the mud puppy are the Texas blind salamander (*Typhlomolge rathbuni*) and the olm or blind proteus (*Proteus anguinas*) of Austria, both snow white. Experiments made with the blind proteus show that in strong light it eventually turns jet black. These animals naturally seek the darkness to which they are so well adapted and do not make records of longevity if kept in the light.

Many of the small salamanders find favor in our home aquariums and terrariums, the yellow-green newt (*Triturus viridescens*) being most commonly seen in the pet shops, where it is sold as the "water lizard." Many people who own these newts are unaware that in their native haunts they have a habit of quitting the water, changing their aquatic dress for an orange-red one, and taking up life on land for a year or so at a time. Sometimes if we overturn a stone in the damp woods, we find nestling beneath it a red eft, which is none other than our common green newt in its gay, terrestrial guise. This species, of wide distribution and abounding numbers, ranges from Canada south to Texas and west to Oklahoma.

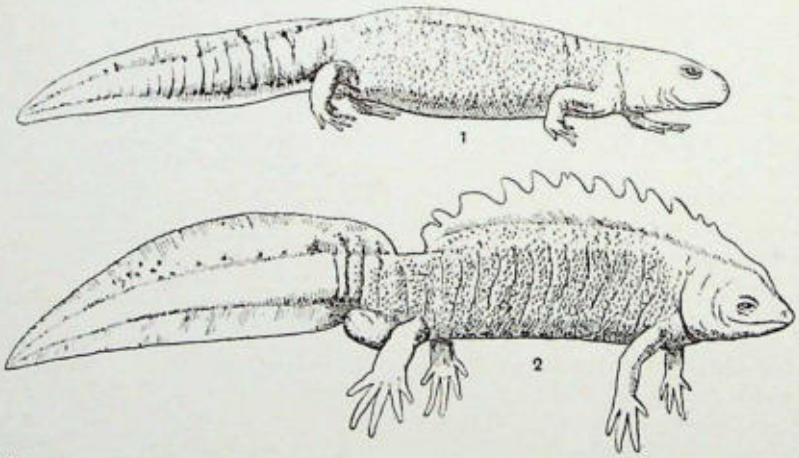
Another popular little animal for the home aquarium or terrarium is the Asiatic red-bellied salamander (*Triturus pyrrhogaster*), small, black-backed, and with blood-red markings beneath, that make a picturesque pattern seldom alike in any two specimens. It shows more intelligence than most salamanders, and therefore makes an interesting pet.

The larvae of salamanders in general lend themselves well to biological study, as their development can be retarded indefinitely in cold, flowing water and their early phases observed at length.

One of the chief benefits in being born an amphibian lies in the power to regenerate lost limbs. Frogs and toads can regenerate well only in their very early stages, but many salamanders can lose tail or leg and easily grow a new one. Axolotls at the New York Aquarium that had their digits eaten off by some voracious sunfishes, were able within three months to replace them, and the European newt or triton is especially well protected, in that it can grow new legs and tail repeatedly, and when alarmed its skin gives forth so poisonous an exudation that few snakes will touch it and it is said that a frog that eats a triton seldom lives to try



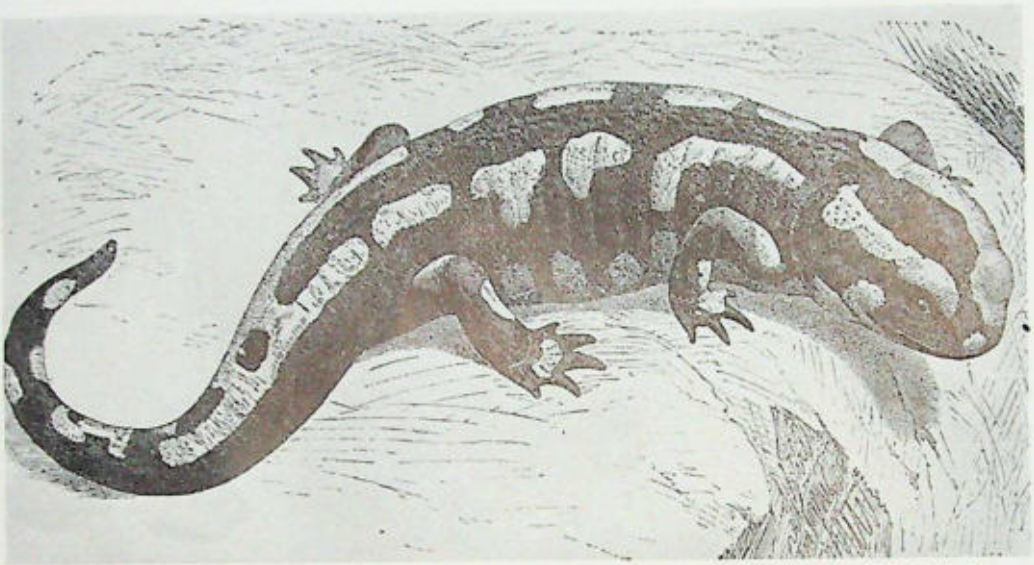
The blind Proteus or Olm of Austrian caves is a white animal faintly flushed with rose, and has bushy gills of carmine red. Upper left—front view of head. From the Cambridge Natural History.



In the little European crested Newt or Triton the male is distinguished by his dorsal crest and broad tail. The eggs of this species are laid singly on submerged leaves. From the Cambridge Natural History.

In an artesian well near San Marcos, Texas, and nowhere else, is found the Texas Blind Salamander, snow white and with blood-red gills. The specimen shown lived for one year in the New York Aquarium.

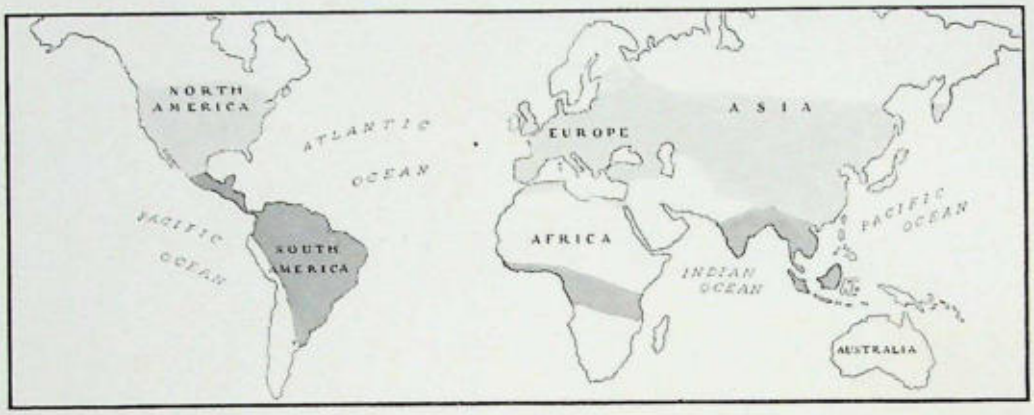
Photograph by Leonard B. Spencer



The fire salamander of Europe, like many poisonous amphibians, is marked conspicuously with yellow, which is believed to warn its enemies. The little animal has been a great martyr to the foolish superstition that it can live in fire, and many people have firmly believed that they saw it creeping in the smoldering embers. From The Standard Natural History.

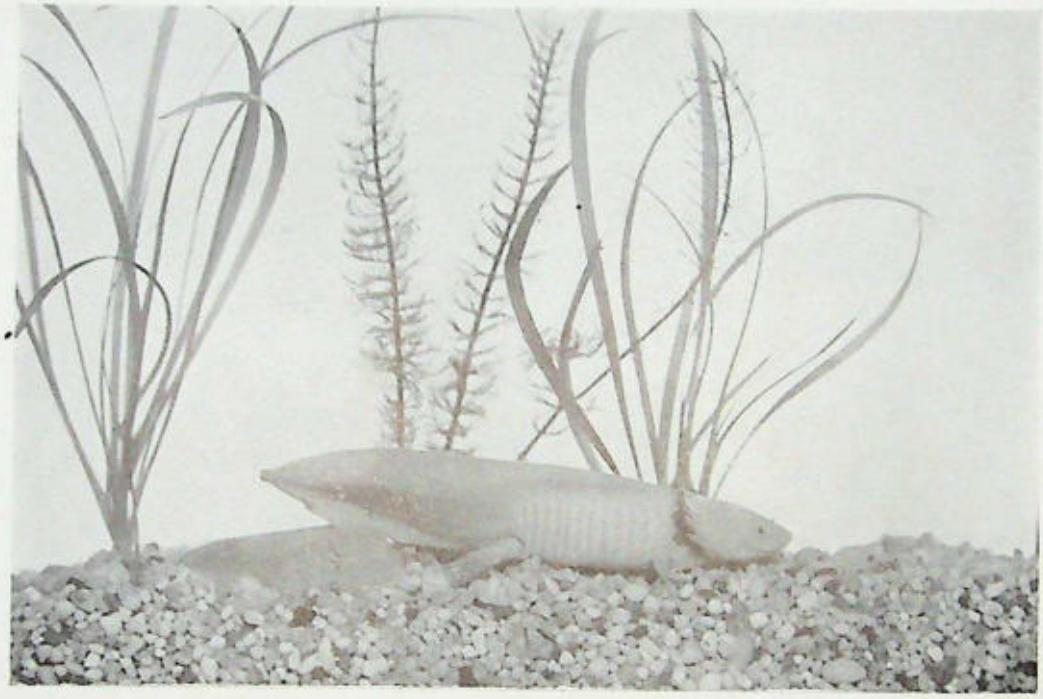
The spotted newt or "water lizard" of the pet shops is extremely abundant in the United States and is familiar to many amateur aquarists. The adults breathe entirely with lungs and sometimes leave the water for a year or so, changing their yellow-green coat for a scarlet one and living under stones and fallen leaves.

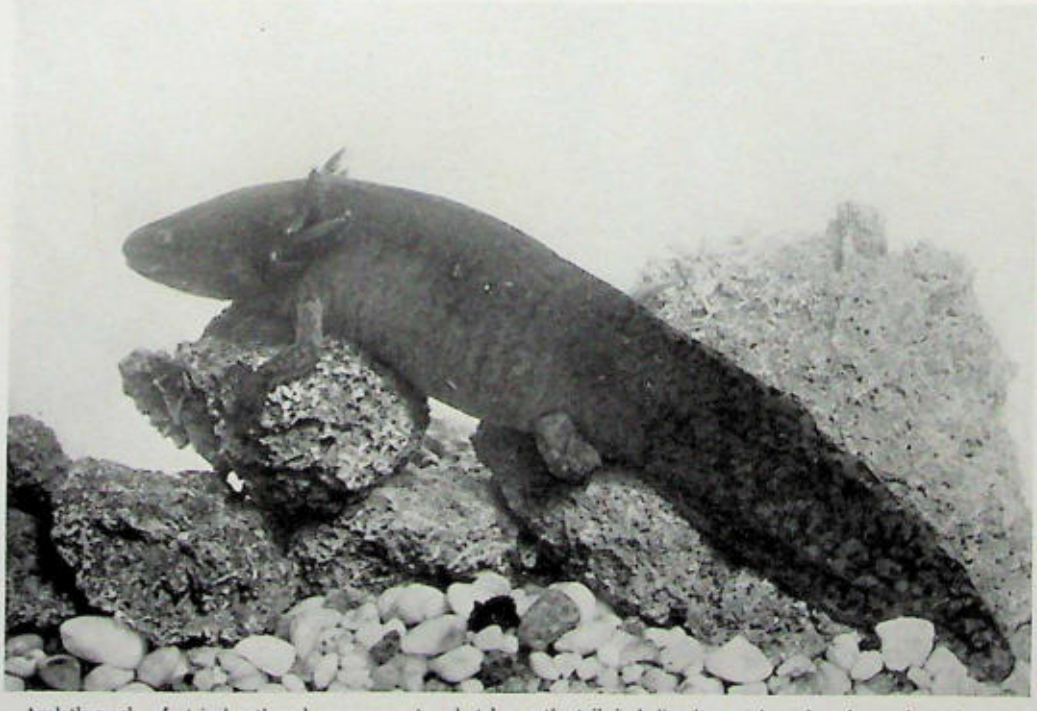
Eel-like, the siren of the southeastern United States is, in the possession of but two legs, intermediate between the rare, legless caecilians and the numerous four-legged salamanders. A close-up view shows how small these two little legs are, as though in process of disappearing altogether.



Distribution of the Salamanders and Caecilians. The lighter tones on the maps indicate the range of the Salamanders, and the dark tones the Caecilians. The range of the Salamanders also extends through Central America and for a short distance into the northern part of western South America. One Salamander *Amblystoma macrotium* breeds in the Rockies at an elevation of 8000 feet. After Gadow.

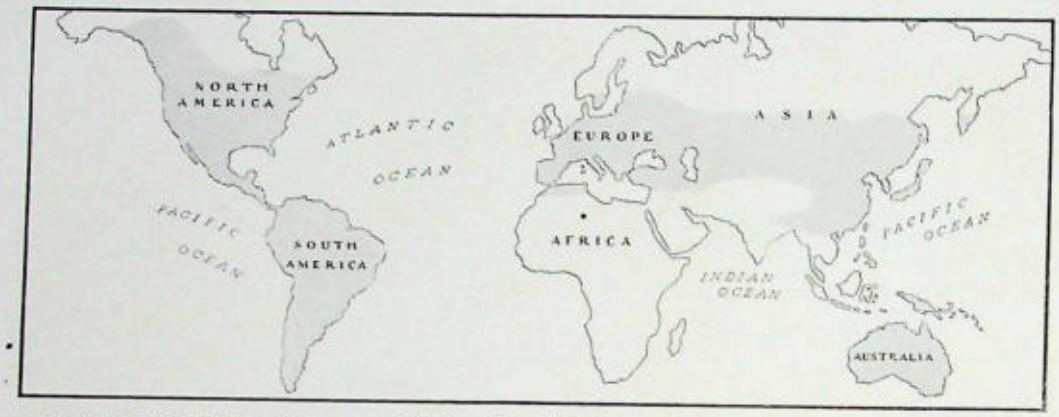
In the case of the snake-like Congo "eel," which inhabits the swamps and sluggish streams of our southern states, one needs to look twice to discover the four rudimentary legs, without which the animal would apparently get along just as well. It is a hardy species that will live in captivity for upwards of five years.



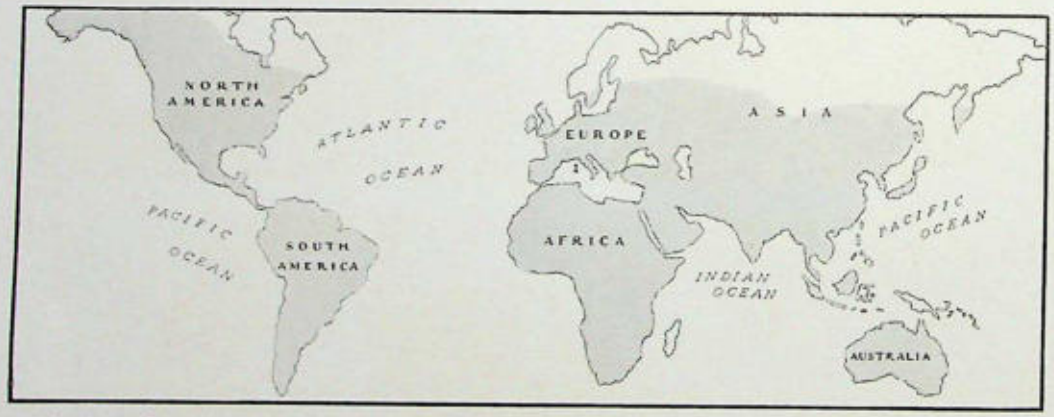


Axolotls reach a foot in length and can regenerate a lost leg or the tail, including its vertebrae, in a few weeks, and some specimens are albinos, like the one shown in the upper figure. The external gills may be retained through life, or the animal may metamorphose. It is peculiar in that it breeds in both larval and adult stage, and the adult, known as the tiger salamander, is smaller than the axolotl.

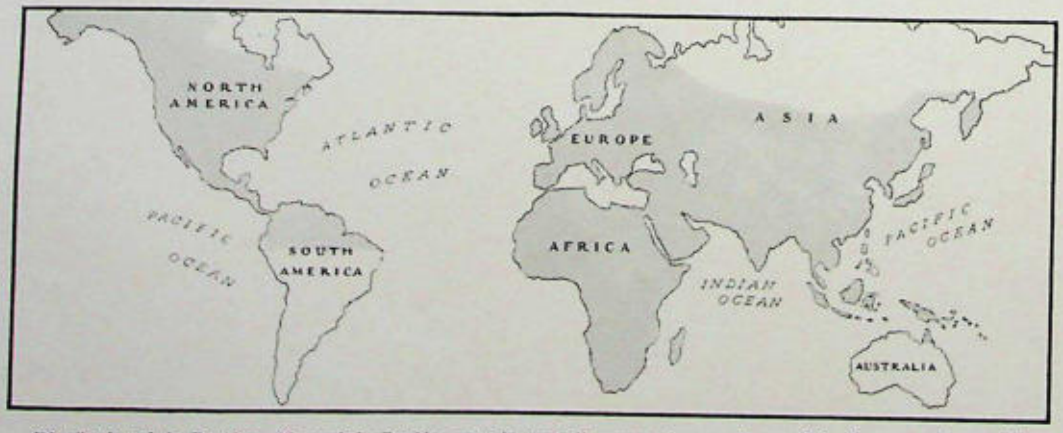
American newts are appealing little creatures that captivate the fancy of the lover of water animals. These pictures show the golden-brown California newt, a species about five inches long, which grows very tame in captivity and will live for several years on a diet of worms and beef, fish and shellfish.



Distribution of the Hyla and other genera of Hylidae. The moist and steamy forests of South America are a paradise for tree-frogs, and this country, especially the Andes section and the adjoining Central American country is the habitat of the greatest diversity of genera and species. Similar regions—however—such as Borneo and the Malay Archipelago are entirely devoid of Hylidae; a modified form of Ranidae, *Rhacophorus*, as shown on page 203, taking its place. A similar condition exists in the tropical evergreen forests of Africa and Madagascar. After Gadow.



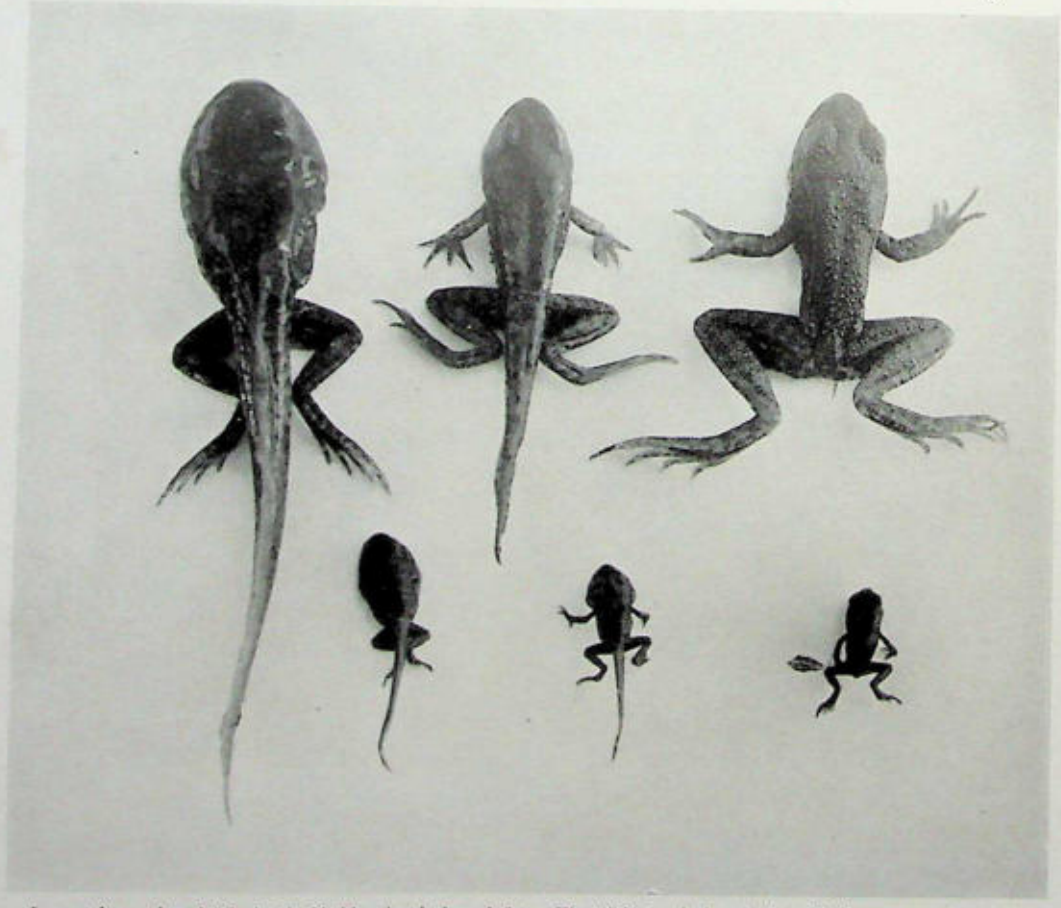
Distribution of the Bufonidae. This also covers the habitat of forms with finger discs and others besides Bufo. The distribution is nearly cosmopolitan except Madagascar, Papuasia and the lesser Pacific Islands. The largest number of genera live in Central America, but in Australia Bufo does not occur. After Gadow.



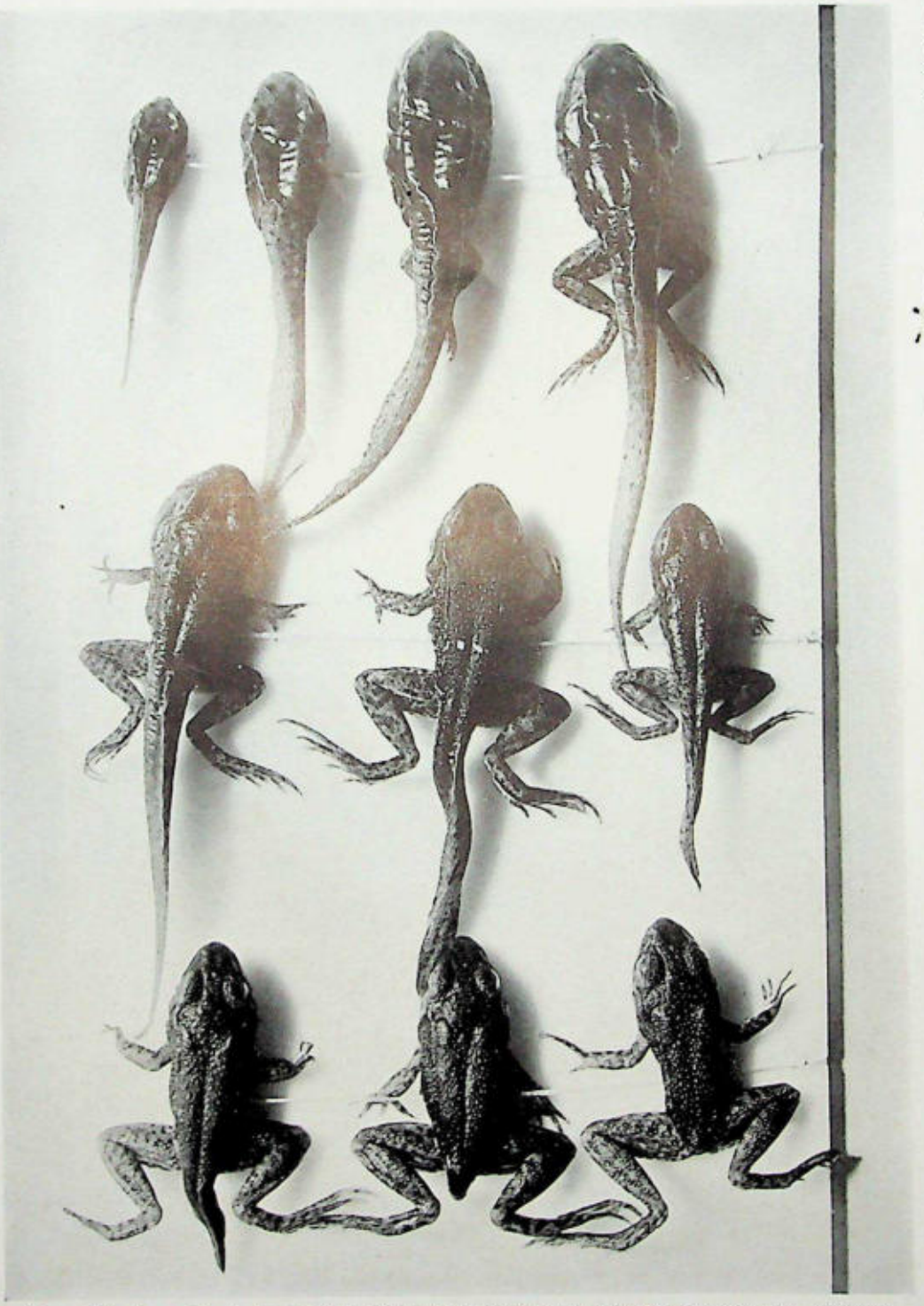
Distribution of the Ranidae. None of the Ranidae occur in Australia—except in a small area of the Papuan region—and in South America they are entirely absent except in the northern part. The range of some of the Ranidae extends into the Arctic circle, and one *Rana septentrionalis* ranges to northern Labrador, where the climate is as extreme as southern Greenland. They also are found in the Yukon River. After Gadow.

Bullfrogs are the largest American frogs. In the male (upper figure) is distinguishable the larger tympanum—a circular patch of tightly drawn skin behind the eye, which is connected with the middle ear and constitutes an accessory auditory apparatus or ear drum. The vocal organs are also more highly developed in the male. Bullfrogs differ from other frogs in the absence of lateral ridges.

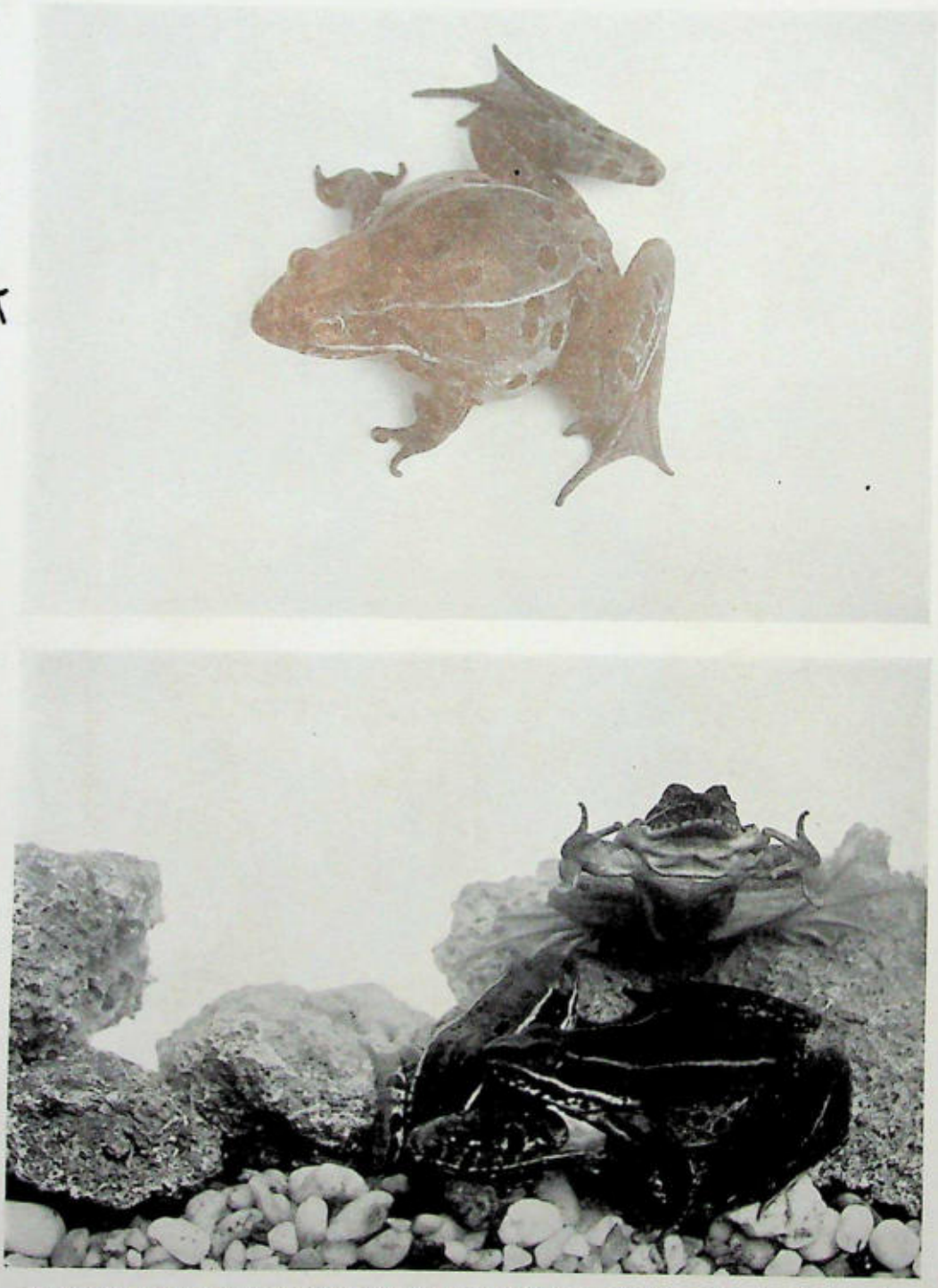
The burrowing spadefoot toad is seldom seen, as it is strictly nocturnal excepting that during the breeding season it may appear in great numbers. It then seeks the water, remaining for a day or two and laying its eggs in bunches, attached to the vegetation. The seal-brown tadpoles emerge in about ten days.—*Photograph by L. L. Mowbray.*



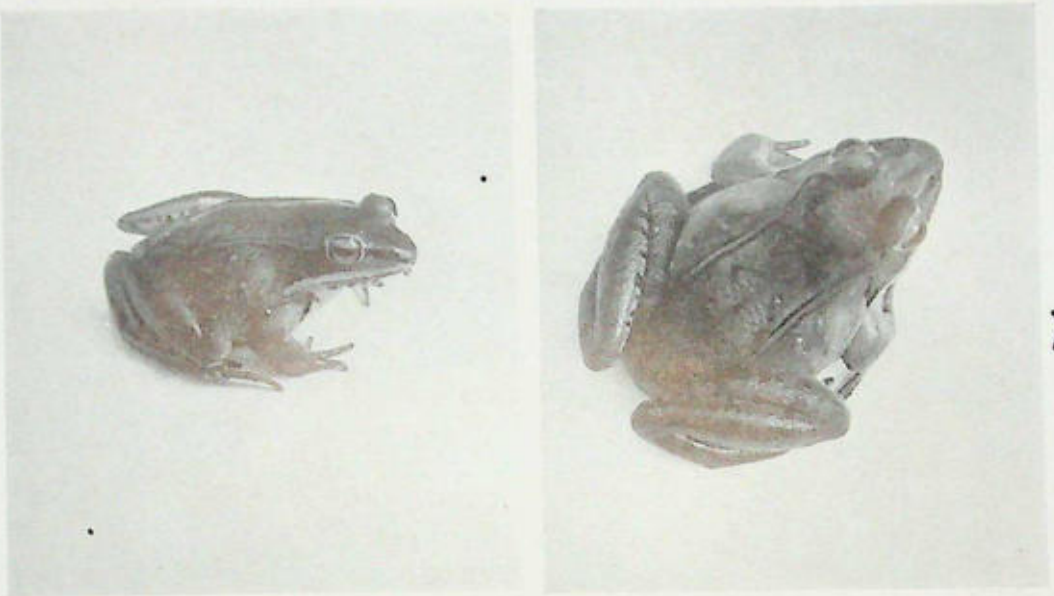
In most frog and toad tadpoles the hind legs break through first. The tail is absorbed gradually while the metamorphosis is in progress, until it disappears altogether. The picture shows the relative size of frog (upper) and toad (lower) tadpoles, and young on metamorphosing.



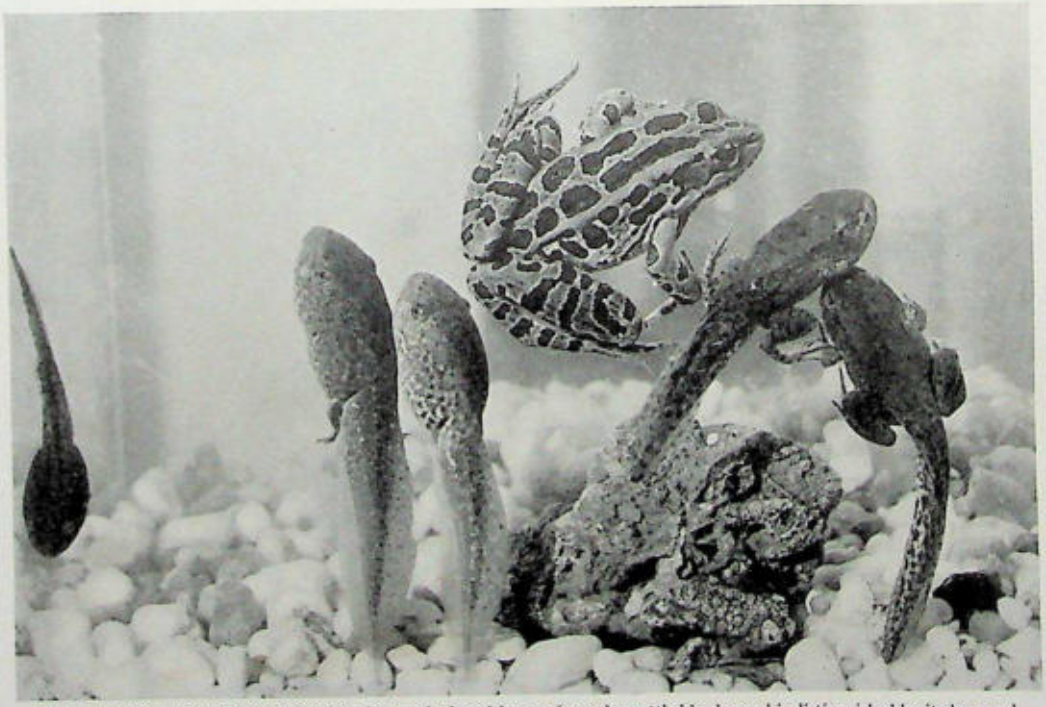
Here we follow the complete development of a frog from the long-tailed, legless tadpole or pollywog, to the tailless, four-legged, perfect frog. The growth of the legs and gradual absorption of the tail are shown, also the characteristic toes, which in toads and frogs generally number four in the front feet and five in the hind feet.



The pickerel frog (*Rana palustris*), smooth and artistically shaped, is one of the species most common in eastern North America. Its conspicuous lateral ridges, as well as a touch of orange under the hind legs, distinguish it from other frogs. The color is golden and burnished bronze in sunlight, and the frog spends much of its time foraging on land. The fondness of the pickerel for this frog has given it its name.



The eastern wood frog (*Rana sylvatica*) varies from yellow to brown in color, the skin being smooth and the head broad and pointed. An inconspicuous dweller in mossy groves and damp woodlands, it is distinguishable by the yellow line running from upper jaw to shoulder and the black head-markings. Its eggs are laid in shallow water.



The leopard frog (*Rana pipiens*) develops from tadpoles with conspicuously mottled backs, and is distinguished by its long and slender body, strong hind legs, and large patches of brown and black on the back and legs.

The handsome leopard frog is light-colored beneath like so many other aquatic animals. It is the most widely distributed of North American frogs, ranging east and south and as far west as the Sierra Nevadas. It is respected by snakes because of its irritating secretions.

The smooth-clawed frogs of Africa (*Xenopus laevis*) are strong little amphibians that live almost exclusively in the water. The small, short digits of the fore feet are sharply pointed and serve as tactile organs, and the species is hardy, living and breeding in captivity.

another. The male of this species wears a gay dorsal crest, which no doubt is a fascinating sight to his plain little mate.

Absurd superstitions have attached to the amphibians, particularly in European countries and Great Britain. A newt of Ireland, alpluachra (species unknown) is believed to jump down people's throats if they fall asleep near a pond with their mouths open; and strange tales are told of these small, water-loving animals living in human stomachs. The way to get rid of one, incidentally, is to lie down near a pond and go to sleep again with the mouth open. The creature, we are assured, will then leave its human host to get a drink, and, if the sleeper is awakened before his guest returns, he may thenceforward have his stomach to himself.

We are all familiar with the unfounded notions that toads give warts, and that they rain down.

It was a cruel superstition that attached for many centuries to the fire salamander of Europe (*Salamandra maculosa*) and still is believed by many persons, even in the United States. A history of the superstition, which is to the effect that this salamander can live in flames, and which caused the immolation of thousands of the unfortunate little animals, was published in the BULLETIN for March, 1917. (The Salamander-in-the-Fire Myth.)

In our own southern states the harmless "two-legged mud eel" or great siren (*Siren lacertina*), a salamander with no hind legs and sometimes growing larger than the hellbender, is believed by the negroes to be extremely poisonous and also to possess many evil powers. The witches of the Middle Ages left their mark:

> "Eye of newt and toe of frog, * * * *
> For a charm of powerful trouble,
> Like a hell-broth boil and bubble."

Now, it is estimated that there are in the world no less than 900 species of frogs and toads, as many as sixty belonging to the United States. Anyone, therefore, who sets out to familiarize himself with all, will find that he has chosen a pleasant but a rather extended task. The animals in this group, sometimes called "batrachians" from *batrachos* (Gr.)—frog, are not as shy as the salamanders and are therefore better known. Frogs, at any rate, have made themselves heard in the world with their spring and summer concerts, and an eight inch bullfrog is no mean bugler:

> "Old croakers, deacons of the mire,
> That led the deep, batrachian choir."

Moreover, the bullfrog (*Rana catesbiana*) is not a victim of ophiophobia—the fear of snakes—so deeply ingrained in other frogs and toads; in fact, a bullfrog likes nothing better for breakfast than a snake of suitable size. Water beetles and insects, crayfishes, fishes, snails, all are found on the bullfrog's bill of fare, also ducklings and other birds, water rats—and, alas, cannibal that it is, tadpoles and frogs, also.

In point of size, the bullfrog has but one rival—the giant frog appropriately called *Rana goliath*, which inhabits French West Africa and is described in a recent book by Dr. Thomas Barbour as being "heavy as a good-sized terrier."

Not only in point of size, but in vocal ability, the bullfrog seldom is outdone. In this country its only rivals are the curious, burrowing spadefoot toads, the vocal sac in whose little throats is equipped for tooting like a steam whistle. This sac, when in action, swells to three times the size of the animal's head. Our hermit spadefoot (*Scaphiopus holbrooki*), one of the two United States species, its queer eyes with their vertical pupils, its hind feet with their spade-like capacity for digging, and its interesting metamorphosis from the almost transparent tadpoles in which the operation of the internal machinery can be plainly seen, was described in the BULLETIN for November, 1917.

Eyes and teeth are subject to wide variations in the frogs and toads. Some have vertical pupils, some horizontal, some round, and one species has a triangular pupil. Teeth may be wholly absent, as in our common toads, or they may be present in the upper jaw, the lower jaw, or both jaws.

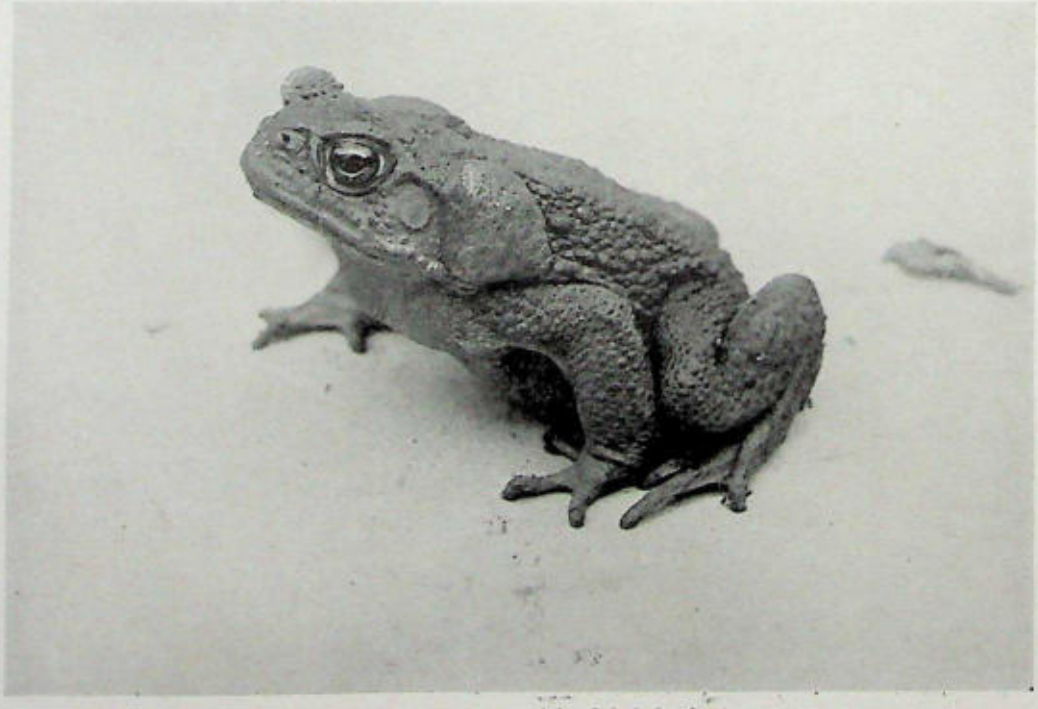
A toad remains a tadpole only one or two months, but some of the frogs, notably the bullfrog and pond frog (*Rana clamitans*) continue in the tadpole stage—or pollywog stage, as it is also called—for two years. In our home aquariums, tadpoles may be observed making frequent visits to the surface to suck in air. This is necessary in the development of the lungs, and the animals can be prevented indefinitely from metamorphosing into frogs, by the simple expedient of keeping them below the surface. A man once kept some in the tadpole stage for seven years by placing a screen below the surface of the water so that the animals could not rise for air.

Amphibians in general are not the wholly helpless group that they appear at first glance, for many are provided with poison-secreting glands which save them from complete destruction.

California toads, like our eastern species, are great destroyers of worms, insects, caterpillars, bugs and beetles. They become so distended with food that their bulging sides fairly drag on the ground.

Sometimes the toad inflates until its body is almost round and the skin tightened, not with food, but deliberately when angered or frightened, making itself look as big as possible in the hope of terrifying its aggressor.

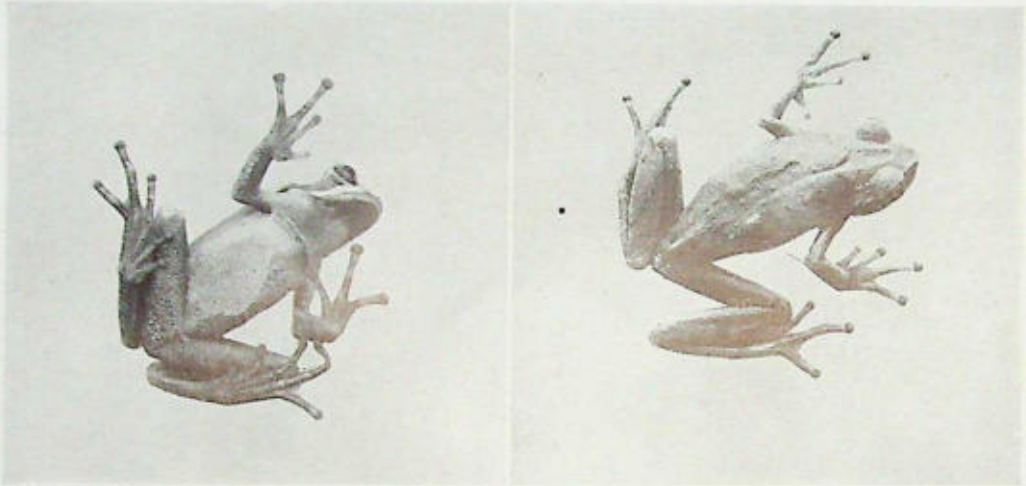
This picture shows the typical markings and warty tubercles of the common toad, *Bufo americanus*, familiar everywhere as the friend of man.



The marine toad is shown in this picture, about one-half the natural size. It is the largest of toads and inhabits tropical America.

Nocturnal habits and a chameleon-like capacity for changing color, protect the tree frogs from their enemies, the birds and snakes.

A remarkable instance of protective coloration in the common tree frog of the eastern states, *Hyla versicolor*. The color and pattern blend perfectly with the bark of the tree. This species measures but two inches in length and the skin is coarsely tubercled.



The large discs on fingers and toes of tree frogs secrete a sticky substance which enables them to cling to both smooth and rough surfaces. The specimens shown were photographed on the glass of an aquarium tank, to show their clinging power.

This illustration shows the enlargement of the vocal sac which enables the frog to produce its shrill, piping call. From the Frog Group in the American Museum of Natural History.

The fire salamander, harmless enough if handled gently, is poisonous if maltreated, exuding a milk-white fluid which it can squirt in a fine jet for the distance of a foot. This is very painful to the eye, and the poison is deadly to a frog that swallows one of the animals. Fire salamanders are black with the bright yellow markings often found in poisonous species in this group of animals. The conspicuous yellow is believed to act as a warning color to enemies.

Our American leopard frog (*Rana pipiens*) exudes a secretion that makes a snake's mouth and throat so sore that these reptiles as a rule respect it. The common toad exudes a secretion so distasteful that some animals such as dogs will not tackle a second specimen. The grass snake, however, preys upon it. In *Pleurodeles*, a European salamander, the sharp ribs perforate the animal's skin, forming a barricade of small sabres on each side of the body, which would stick rather unpleasantly in the throat of a foe; and the frogs of one genus (*Rhacophorus*) use their enormously webbed members as parachutes, which undoubtedly helps them to escape from arboreal pursuers. So virulent is the poison of one South American tree-frog (*Dendrobates tinctorius*) that the Indians have used it to poison their arrows, especially those used in shooting monkeys, its action on the central nervous system being deadly. We are told on good authority that this poison also is used to change the color of the Amazon green parrot! The story is that if some of the bird's feathers are plucked and the place smeared with this poison—usually supplied by rubbing with the live frog—those feathers which were originally green will be replaced by yellow ones, making a variegated bird.

The supply and demand of frogs varies amusingly. In some places they are so numerous that bathers complain they cannot enter a lake without crushing some of the slippery creatures underfoot, and they write to the Aquarium for advice on how to get rid of them. Other people are equally eager to learn how to acquire frogs for their house ponds, for the sake of the ornamental qualities of these amphibians. People who have gone frog-hunting during their summer holidays assure us that they never again will kill one of these loudly protesting creatures. Others, looking for an industry that is not overworked, are imbued with the desire to go into frog-raising. One Wisconsin frog farmer is said to ship 2,000,000 frogs' legs a year and to kill the animals by placing them in electrically charged water. It is fitting that the delicacy of frogs' legs was discovered by Roman epicures. Their taste for these amphibians was later rivaled by the French, who, not so long ago, were looked upon as a nation of frog-eaters; but to-day Americans are the greatest consumers of frogs. The United States Government publishes a booklet on the history and utilization of frogs, and more than fifteen species in this country have been named as edible, including the green, leopard and pickerel frogs, and the common and western bullfrogs. If the craze for frogs' legs continues to grow, these animals, in a few years, will probably become scarce through overfishing, like oysters, lobsters, sturgeons, and some other aquatic forms.

The question now seems to be, Shall we become toad-eaters? since it has been suggested that the common toad may serve for human food. Thus to destroy it would indeed be the height of folly, for, although the toad lays from 2,000 to 6,000 eggs, the young have so many natural enemies that toads never are superabundant. To the farmer, the busy toads have an economic value estimated at no less than $20 apiece each year, for during a single summer one specimen consumes about 10,000 garden pests.

Many people have had the pleasure of watching the long-tongued frogs and toads capture their prey. The sticky tongue, fastened to the front of the mouth, is thrust out, glued to some hapless caterpillar, worm, spider, fly or other insect, and returned to the mouth with the prey, almost too rapidly for the human eye to follow. Mary Dickerson, in her charming and classic Frog Book, explains that when a toad shuts its eyes hard after swallowing a bulky worm or beetle, it is because the eyes can be depressed as far as they can be protruded and are used to help push the meal down the throat!

More than 100 species of the toad, *Bufo*, have been classified. Like the bullfrog, *Bufo* does not attain full maturity for five years. Largest of all the toads is a South American species, *B. marinus*, which grows to be six inches long and four inches wide.

Perhaps the most alluring of all amphibians are the tree-frogs, which hatch in water like the others and have the power to change their colors like chameleons. They have a pleasing voice, brilliant eyes, and a confiding manner that make them popular in the terrarium; and by feeding them in the fashion described in the accompanying paper, one can maintain them for several years in captivity. The Cambridge Natural History tells of a tree frog that lived in confinement for twenty-two years.

Tree frogs do well in a terrarium and grow so fond of bits of beef that they eventually scorn in its favor their natural insect food. The species shown are tropical and gorgeously daring in color as any mackaw or parrot—warm silver gray, brilliant green, and vermilion.

A study of the comparative sizes of tree frog, common toad and marine toad. Frogs and toads never sympathize or cooperate with the photographer but have a tantalizing habit of sitting very still until his camera is placed and he is ready to make the exposure, and then suddenly hopping away.

THE CARE OF SALAMANDERS AND FROGS IN CAPTIVITY*

By Ida Mellen

SALAMANDERS and frogs are included among the animals classified as Amphibians, those leading a "double" life. They are born in the water and pass through a gilled, tadpole stage, later undergoing metamorphosis and developing lungs for air breathing. The majority live both on land and in the water, but some forms adopt a land life, returning to the water only during the breeding season, to deposit their eggs.

Salamanders frequently are confused with lizards because of a resemblance in the shape of their bodies, and pet shops sell them under the cognomen of "water lizards." The salamander is a smooth-skinned, air and water breathing animal—an amphibian, while the lizard is a scaly reptile, born on land, living in dry places and never provided with gills.

Salamanders should be provided with aquaria or tanks so arranged that they may pass in and out of the water at will. This can be accomplished by placing rocks, sand, gravel or moss in the receptacle. Large salamanders such as the hellbender (*Cryptobranchus alleganiensis*), mud puppy (*Necturus maculosus*), and giant salamander of Japan (*Megalobatrachus japonicus*), require running water, which for these species need not be warmed in winter. In fact, all salamanders thrive in running water, but the smaller varieties have been kept successfully in still water changed daily. Those that are fed live food can catch their prey better in shallow water. The temperature of the water for all the smaller salamanders except the Shasta salamander (*Ambystoma tenebrosus*) should be maintained at from 68° to 75° Fahr. For the Shasta salamander, accustomed to cold mountain streams, the water should not be allowed to rise above 72° Fahr.

The blotched (also called marbled and opaque) salamander (*A. opacum*) is fond of sandy soil.

The natural food of all varieties of the salamander consists, for the most part, of water plants, worms, insects and water beetles, spiders, crustacea (shrimps, crayfishes, sow-bugs and the like), mollusks such as snails, slugs and mussels, fishes and their eggs, and one another. Large salamanders add small frogs to their menu. In captivity nearly all salamanders eat meal worms, earthworms, fresh meat and fish. The author has found that they thrive best on raw fish with the bone ground in, an ideal food for building bone and tissue and for keeping the skin healthy. They like live minnows and any kind of fish, although most amphibians (and also reptiles) do better if fed on fresh-water fish, which they prefer to the salt water kinds.

It is said that wire worms will attack and kill the common green newt (*Triturus viridescens*), a danger to be guarded against if this species is placed in a terrarium with fresh earth. The animal adapts itself, at irregular intervals, to a terrestrial existence. On first leaving the water it becomes of a brownish hue, and after being for some time on land assumes a brilliant, orange-red. In this state it lives in damp woods, under stones and fallen leaves, and if taken captive can be maintained in a terrarium well supplied with damp moss, where it will eat small insects, meal worms, earthworms, and other foods similar to those it takes while living in the water. On returning to an aquatic life, it again acquires the characteristic green color. While living on land, it is known as the red eft.

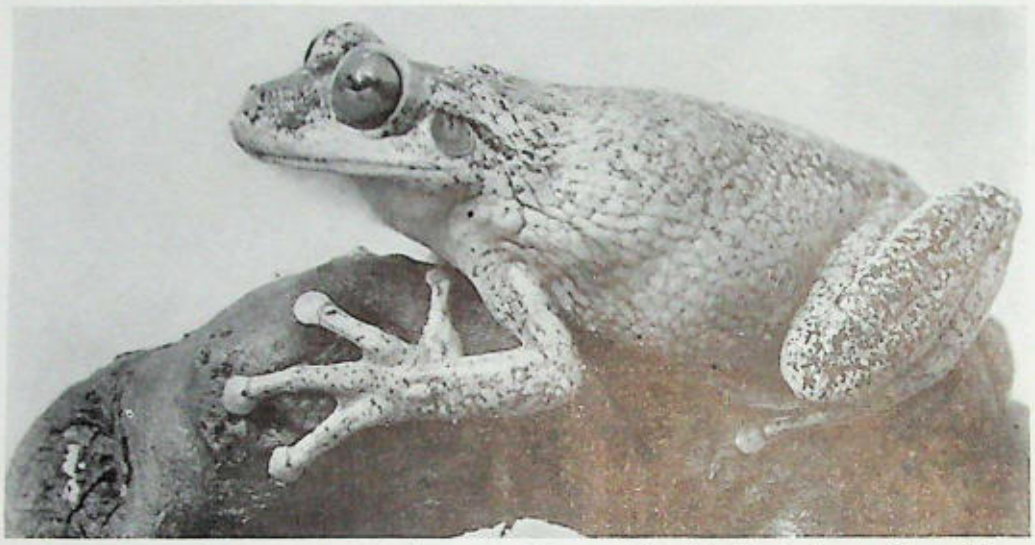
The common newt has lived in the Aquarium for three years. It accepts food during all seasons, although the California newt is said to eat very little sometimes, for months at a time. The blotched, tiger, spotted, red, red-bellied, slimy, Shasta and blind salamanders have survived for from one to three years, and the Congo "eel" for five years; while of the three largest salamanders, the mud puppy or water dog has lived in the Aquarium for four years, the hellbender five years and giant nineteen years.

Salamanders' eggs, like frogs' eggs, will hatch in still water and it is not difficult to rear the young.

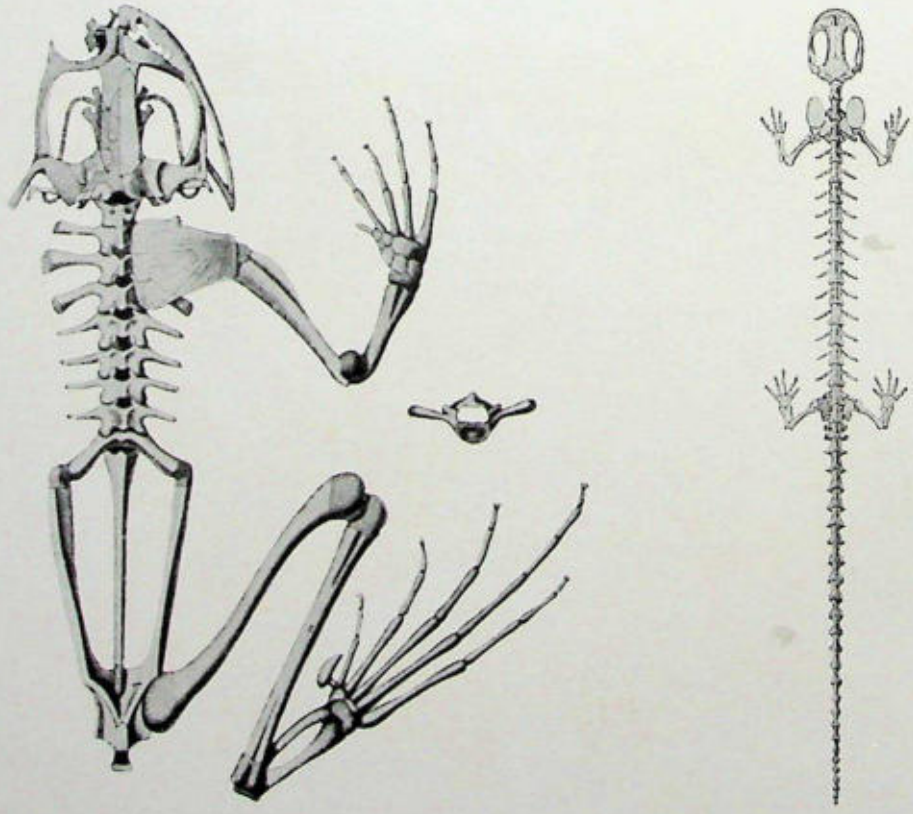
Turtles and fishes should not be kept with salamanders, both having a special fondness for nibbling the toes of these creatures. If salamanders have sustained injuries or are suffering from skin diseases, paint their skins with a two percent. solution of mercurochrome. One or two applications generally effect a cure. In the case of injured spots or members on which parasitic white fungus (*Saprolegnia*) has developed, brush the affected parts with kerosene oil, wash off the oil in clear water, and place the animals in a mud bath for a few weeks. Feed regularly and they will recover. They will also regenerate any lost members, although the process is a slow one, and it will be some months before complete restoration of the parts is made.

Most salamanders and all frogs are cannibals,

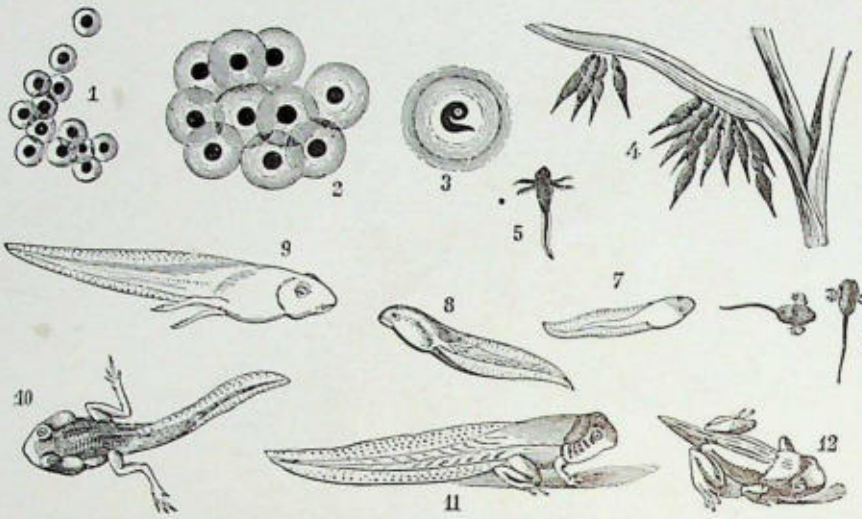
* This is a revision of Miss Mellen's article on this subject published in the Bulletin for March, 1917. It was reprinted as Information Circular No. 4, which is now out of print. The present paper will be reprinted as a new Information Circular No. 4, the subject being one upon which the Aquarium is frequently asked to give information and advice.



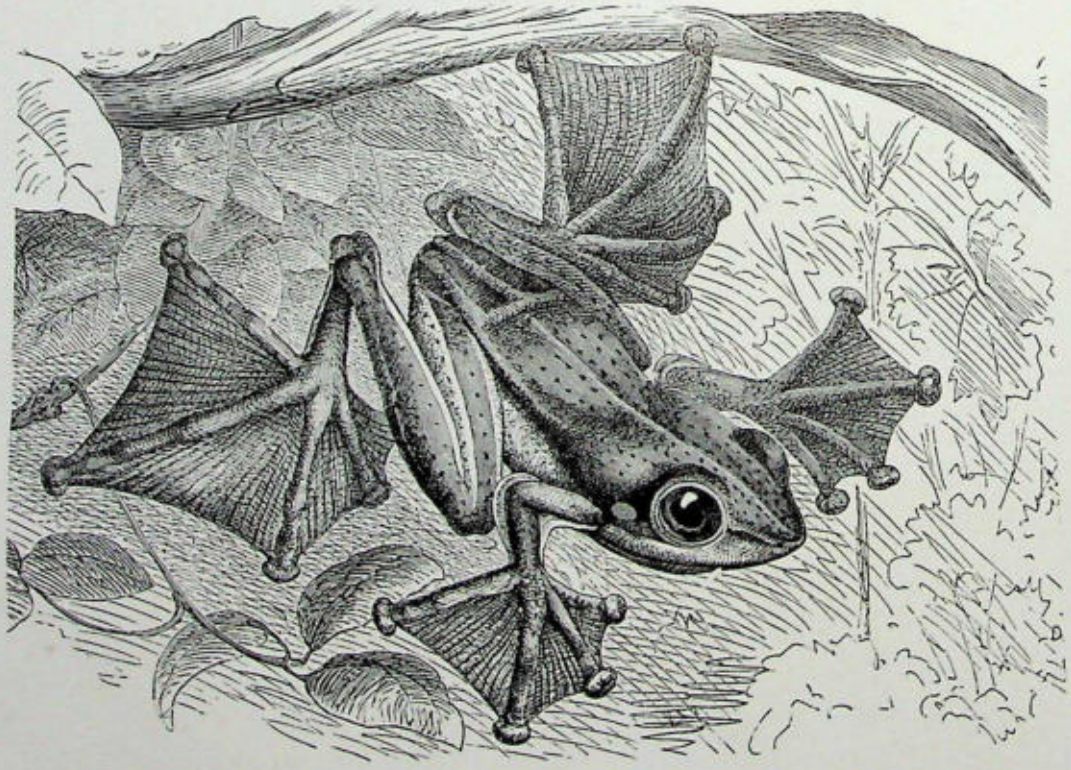
A huge tree frog of the tropics (same specimen shown on page 199, upper right), which illustrates the powerful grasp of the fingers and their large discs.



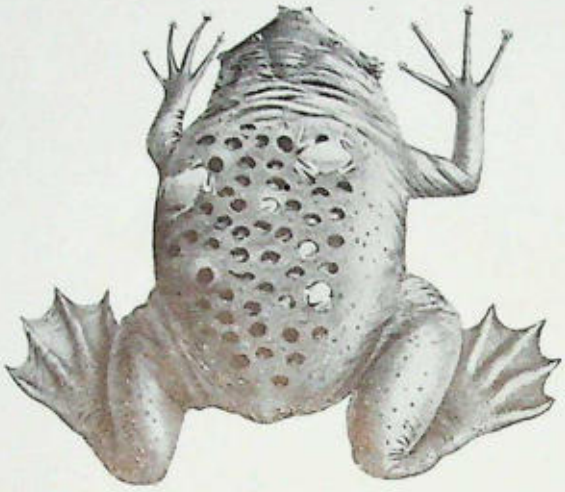
A skeleton of *Rana temporaria*, the common British species of frog, illustrates the shortness of the vertebral column in these animals. It is at the end of the nine vertebrae that the characteristic hump appears in the back. The smaller picture shows the fourth vertebra. The skeleton of a salamander (*Spelerpes bellii*) shows the extension of the vertebral column to the tip of the tail, with three times as many vertebrae as the frog has. From Parker and Haswell's Text Book of Zoology and The Standard Natural History.



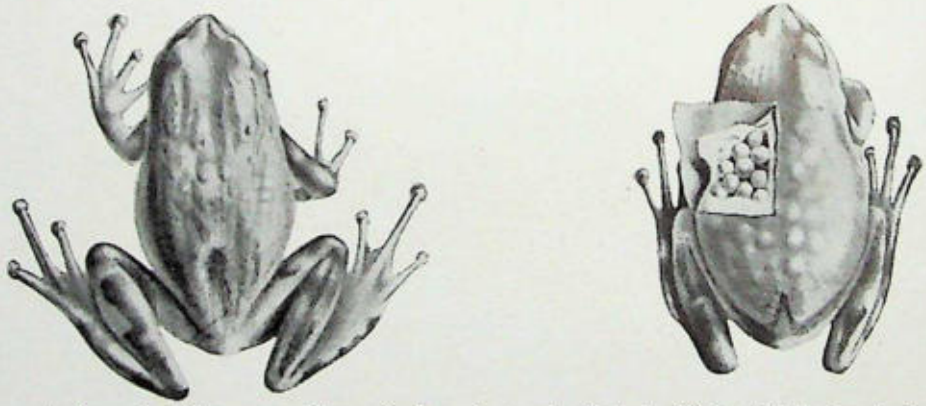
Eggs of frogs are laid in masses in April, May and early June, while toads' eggs are laid in long, double strings during late April and the month of May. Development is similar, but toads hatch quicker and are much smaller on taking to land. The progress of development can be followed by referring to the figures. Nos. 5 and 6 show the external gills, soon lost as shown in No. 7. From The Royal Natural History.



The flying frog (*Rhacophorus*) of the Malayan Islands, uses its broadly webbed feet as parachutes. Wallace first described the species, which was called to his attention by a Chinaman who had seen it descending from a tree in Borneo. From The Royal Natural History.



The female Surinam toad of northern South America, with webbed hind feet and star-shaped lobes on forefeet digits, carries her eggs in pits in her back, where the young pass through the tadpole stage and hatch out perfect little toads.



Another species, *Notorema marsupiatum*, carries the eggs in a pouch on the back. This is a South American tree frog.

In a tree frog of Brazil, *Hyla goeldii*, the female carries 26 large eggs on her back, the skin of which extends into a supporting border. (a) From above, (b) from side, (c) young when hatched. From Reptiles, Amphibians and Fishes. Edited by J. H. Cunningham.

at least in captivity. To prevent loss of stock, therefore, care should be taken to place together only those of approximately the same size.

A limited number of frogs in the tadpole stage may be kept in the balanced aquarium. They thrive in the temperature of the living room. One tadpole is sufficient in aquaria of under eight gallons' capacity. It will eat water weeds, raw meat and fish, shellfish such as ground clam and mussel, also cereals raw or cooked.

Adult frogs, being provided with lungs, cannot survive unless permitted to leave the water for air. They devour almost any live moving object that it is possible for them to swallow. Every small, living thing is acceptable that passes within range of their eversible tongues,—grasshoppers, snails, spiders, crickets, worms, beetles, crustacea (especially sow-bugs), and other frogs. The bull frog, in addition to all these items, seeks larger fry, and besides preying extensively on its own kind, is said to find palatable small fishes, snakes, shrimps and crayfishes, likewise young turtles, field mice, young ducks and other small water birds.

Some frogs, such as bull frogs and green frogs, remain for two years in the tadpole stage. Bullfrogs attain their full growth in five years, but breed at three years, spawning in May and June. They occasionally reach a length of over eighteen inches and a weight of seven pounds.

The leopard frog, also called grass frog, shad frog and common frog, is the most widely distributed of North American frogs and has the reputation of making the best pet. Wet moss should be provided for it and a special diet of worms and insects, grasshoppers being particularly relished. This frog is bright green, brown or gray, most specimens being spotted with black, brown and yellow. The pickerel frog is similarly marked, though rather more dotted than splotched, but is colored bright yellow on thighs and legs.

Various species of frogs have been kept at the Aquarium, including the bullfrog (*Rana catesbiana*), leopard frog (*R. pipiens*), pickerel frog (*R. palustrus*), green frog (*R. clamitans*) and wood frog (*R. sylvatica*). They have lived from eight months to two years on a diet of earthworms, meal worms, and beef and liver cut in small strips to resemble worms. These strips are taken if dangled before the animals on a slender stick. In the case of small specimens such as tree frogs, bits of beef can be wound around the end of a thread or string and swung before them. Once they have had the taste of beef, no coaxing is necessary to induce them to feed in this way.

NOTE ON GEORGE SARTON'S "INTRODUCTION TO THE HISTORY OF SCIENCE"

By William Beebe

THE rush and the drive and the superficiality of modern civilized existence have deeply permeated literature. Especially since the war, we have been deluged with a flood of "Outlines" of everything under the sun, and while they must do considerable good, their chief appeal is to people who cherish the hope of a get-wise-quick system. I suppose that the same persons who are satisfied to have their homes decorated and furnished by professionals are content to digest the world's-best-literature, or pictures, or scientific facts as tabloided by other professionals.

Now and then, however, there appears a résumé of knowledge—a sublimated "outline," which marks a fundamental, permanent advance, and as such should be emphasized and appreciated. One which has just appeared is the "Introduction to the History of Science" by Dr. George Sarton. Volume I has been published for the Carnegie Institution of Washington by the Williams and Walker Co. of Baltimore. It covers the ground from Homer to Omar Khayyam. The thirty-four chapters are each devoted to a half century of historical time, extending from the eighth and ninth centuries B. C. to the second half of the eleventh century A. D. To each chapter title the author has allocated the man who dominated his respective two score years and ten. The text as a whole is devoted to brief, excellently written biographies of all notable contributors to science, followed by an annotated bibliography of texts, translations and commentaries.

This note is in no way intended as a thorough, critical review, but merely a desire to share a delightful intellectual discovery with anyone who will be glad to know of it.

I will quote, without comment, a single introductory paragraph of Dr. Sarton's:

"The purpose of this work is to explain briefly, yet as completely as possible, the devel-

opment of one essential phase of human civilization which has not yet received sufficient attention—the development of science, that is of *systematized positive knowledge*. I am not prepared to say that this development is more important than any other aspect of intellectual progress, for example, than the development of religion, or art, or of social justice. But it is equally important; and no history of civilization can be tolerably complete which does not give considerable space to the explanation of scientific progress. If we had any doubts about this, it would suffice to ask ourselves what constitutes the essential difference between our and earlier civilization. Throughout the course of history, in every period, and in almost every country we find a small number of saints, of great artists, of men of science. The saints of today are not necessarily more saintly than those of a thousand years ago; our artists are not necessarily greater than those of early Greece; they are more likely to be inferior; and of course, our men of science are not necessarily more intelligent than those of old; yet one thing is certain, their knowledge is at once more extensive and more accurate. *The acquisition and systematization of positive knowledge is the only human activity which is truly cumulative and progressive.* Our civilization is essentially different from earlier ones, because our knowledge of the world and of ourselves is deeper, more precise, and more certain, because we have gradually learned to disentangle the forces of nature, and because we have contrived, by strict obedience to their laws, to capture them and to divert them to the gratification of our own needs."

AN ALBATROSS AFTERMATH

By William Beebe

AMONG the greatest joys of exploration and the subsequent recording of the results, are the unexpected sidelights and aftermaths on particular episodes. The New York taxicab driver who had been wrecked on the Galapagos,[1] and the wonderfully interesting sea captain whom we found in a New York tenement,[2] who owns half of Cocos Island and had sought for treasure there for twenty years—these are two of the most spectacular afterings of recent trips. And now comes another.

In *The Arcturus Adventure*, page 102, in the chapter on Albatrosses, I wrote the following paragraph:

"There is an authentic record of an invaluable, although it must be admitted involuntary, benefit rendered to man by an albatross. Some years ago there fell exhausted and dying from starvation upon the beach at Freemantle, West Australia, a great albatross. When found, it had a tin plate fastened around its neck on which was scratched the news of the wrecking of the French ship *Tamaris* three weeks before, and the survival of thirteen of her crew on Crozet Island. During this period the albatross had flown over four thousand miles of ocean, too terrified by its burden to stop to feed. It was a remarkable incident, quite reversing the experience of the ancient mariner;

" 'Instead of the cross, the Albatross
About my neck was hung.' "

In connection with this incident I have recently had a letter from Lieutenant-Colonel L. E. Broome of the Royal Engineers, who is now living on Vancouver Island. Colonel Broome is one of the rare living human beings who has not lost the art of letter writing and his entire epistle is so fascinating that I have asked and received permission to reproduce portions of it for the benefit of readers of the Zoological Society Bulletin.

"I have delighted in *'The Arcturus Adventure'* which came to me and was read in a little farmhouse in the forest on Vancouver Island. In your chapter on albatrosses you allude to a tale of one of these birds bearing an S. O. S. message from the Crozets.

"Here's the yarn spun out a bit longer.

"One summer's evening around Christmas in the eighties, I was taken for a walk by my father and mother along the beach on Rottnest Island some twelve miles out to sea from Fremantle (one "e" please, the bulk of the original population being anything but free). I was a small brat of seven or eight and boylike, scampered on ahead to see what was the white thing which was being washed back and forth by the ripples breaking on the beach. I pulled out the albatross of your story by one of its long wings and shouted to my mother and father to come and look at my find. It had the tail of a fat herring sticking out of its beak, being unable to swallow the fish because of the wire around its neck, holding a side of a bully beef tin on which were punched with a nail the words:

" *'Treize naufrages sont dans les Crozets. Au succours pour l'amour de Dieu.'*

"The bird had evidently choked to death quite recently, but yet had laid its pitiful message at our very feet on the shore of the only inhabited bay of the whole island. Now the only com-

[1] Galapagos, p. 295.
[2] The Arcturus Adventure, p. 250.

munication with the mainland at Fremantle in those days was by heliograph, unless one waited for the infrequent trips of the pilot lugger returning from Fremantle after taking a ship in and bringing the pilot back to his station on the island. My father, who was Governor of the Colony, ordered the surveying schooner *Meda*, Capt. Coghlan, R. N., in command, to proceed to the Crozets, to save the men if possible. She was too late, however, and found the cache in the hut which was maintained by the West Australian Government or the Royal Navy, I've forgotten which, empty and signs that the unfortunate '*naufrages*' had left in their ship's boat when starvation stared them in the face after consuming the stores. They were never heard of again—quite the wrong ending and one which spoils the moral which should adorn the tale, namely, that the devoted bird's long flight and unpleasant death should not have been in vain. But the head of the albatross with its poignant tintype was mounted and hung in our billiard room at Government House, where it may be yet for all I know. So much for the long arm of coincidence.

"Your account of your diving adventures in *Helmet* and *Hose* also brought back to me memories of much the same stunt in Nombre di Dios Bay back in 1908, when I was helping to dig the Panama Canal. But I used an ordinary diver's helmet and strung a few necklaces of iron nuts on wire and fastened them around its neck. Then someone lowered it onto my head as I swam alongside. I remember that when sharks came too close for comfort I used to give the airvalve a twist and loose off a barrage of bubbles that would put the wind up the undesirable visitor and cause him or her to disappear in a cloud of mud.

"I can remember well the evil taste of the oily and rubberized air that came to me through the pumps—also the washerwoman's finger effect after long submersion.

"I have spent many an hour mooning about the old forts on the hillside at Porto Bello. On a quiet night one could almost hear the challenge of the sentries. Alas, I had to blast some of their masonry away for the foundations of my rock crusher which was to supply the stone for the concrete of the Gatun Locks and Spillway. They say that the King of Spain was once discovered gazing westward from a window of the Escurial and when asked why so peevish, replied that he was looking to see if the walls of the forts of Porto Bello were showing above the horizon as they had cost him so much. I remember once taking a matter-of-fact young countrywoman of yours over them and, sitting in a gun embrasure, asked her, a trifle intensely perhaps, if she could not hear the rustle of buff jerkin and steel morion and the clank of long Andrea Ferara rapiers as the Dons changed guard. With a nervous look over her shoulder she said she thought it was time to be going back and was quite annoyed because I said 'Mary, pity women.'

"Did you know that you have sailed over the bones of Sir Francis Drake? They lie just outside the entrance to Porto Bello harbour. The bearings, cross bearings and depth are given in one of Hakluyt's voyages, I forget which. He died at sea from fever and wounds after an unsuccessful attempt to take Nombre di Dios, some twenty miles to the eastward, and was put overside all neatly soldered up in sheet lead. Alfred Noyes is out when he speaks of him as 'slung a'tween the round shot, in Nombre Dios Bay.'"

MENURA—AUSTRALIA'S MOCKING-BIRD

By Charles Barrett, C.M.Z.S.

Illustrated with photographs made by the Author.

IT is June, and in slippered ease by the fireside, I hear the wild music of wind and rain —and think of my Lyre-bird friends, in a fern gully, miles away. I know that some pairs will be nesting: building new nurseries, perhaps near those of last season. *Menura* woos in Winter time, and before Spring, should no ill betide, is rearing its young happily.

An old friend has written, recalling incidents of an outing after Lyre-birds we made together, twenty years ago. The memory of journeys to Nature abides. My notebooks of many seasons contain records of delightful, discomfortable days in Fernland, on the trail of *Menura novaehollandiae*, the Superb Lyre-bird, a master mimic, beautiful, engaging in its ways, and owner of what Elliot Coues described as "a wonderful caudal appendage." We claim, too, that, as a mimic, *Menura* has no peer; not even in the mocking-bird of America (*Mimus polyglottus*). But a voice contest between the two species would be diverting indeed!

There are only two species of *Menura:* the Superb Lyre-bird, ranging from Victoria to

The finest fern-gully in Victoria's great National Park, Wilson's Promontory. The Park embraces an area of 101,000 acres and is sanctuary for many native birds and mammals including the Koala. A haunt of the Lyre-bird.

Southern Queensland; and the Albert Lyre-bird (*M. Alberti*), with a more restricted range. The Superb species was discovered in the earliest days of settlement in Australia, and Latham described it in 1801. The pioneer colonists named it pheasant, because its contour, and the long tail, give it a general resemblance to the birds that are so popular with British sportsmen. The aborigines, different tribes, knew it variously as beleck-beleck, balan-gara, and drilk-drilk, the first and last of these titles being imitative of *Menura's* own notes.

It was in January, 1798, that an exploring party in New South Wales returned from the wilds to an infant settlement that was destined to become the great city of Sydney, with one example of a strange, long-tailed bird. The simple-minded men, convicts some of them, had no doubt that they had discovered a pheasant; but the more learned colonists thought that *Menura* was a bird-of-paradise. When specimens reached England, naturalists wondered, and blundered in their wisdom. So singular a bird puzzled the systematists, and it was assigned to different positions by different authorities.

Gould[1] considered the Lyre-bird the most appropriate emblem for Australia; but in our Coat of Arms kangaroo and emu have the honor. For my part, I regard *Menura* as the wonder-bird of my native land, and one of the most remarkable in the world. Its existence is threatened in many of its haunts, by the advance of settlement, and the ravages of foxes (introduced for sport, from England, years ago, and now well described as "a curse to the country"). Tail-hunters, formerly, took heavy toll; but now *Menura* enjoys protection, throughout its range; and there are a few sanctuaries where the birds seem to be increasing.

In the coldest and wettest months of the Austral year, we go after lyre-birds; not to collect, but to observe them, and photograph them if we can. I may be among them tomorrow, for a haunt of theirs in the ranges is not thirty miles from my home. Sherbrook Gully is a tourists' resort; thousands of people go there during week-end holidays, but not in Winter time, when nature lovers, in their rambles, meet few, if any, other folks, deep among the tree-ferns, where the lyre-birds call.

Last season, on a blustering day, I was on the trail at sunrise, with a friend as keen, and as careless of discomfort, as myself. We left the old hut, on a rise, clad poorly as sundowners (tramps of the countryside), but booted stoutly and wearing thick leather leggings. Oilers we had, too, wrapped closely about us; and we needed them, in driving rain. Soon we were off the main track and breaking a path through dense and dripping scrub, gum-tree (eucalyptus) saplings, and other trees, down into the gully. We splashed through pools and liquid mud, clambered over moss-grown logs, and brushed through tall bracken. Not easy going; and for all our protection, we were drenched and mud-flaked when the creek was reached.

I worked up-stream, often finding the big stones laved with water a better pathway than banks that were thick with ferns and sword-grass, crowding trees and shrubs. My companion forced his way through the undergrowth, above the stream, making little side-excursions, now and then.

We were looking for the earliest, occupied, nest of *Menura*, in that bit of Fernland. It was not all tree-gazing. *Menura*, before the fox invaded its haunts, nested nearly always close to the ground, sometimes practically upon it. Experience of the furred raiders, who take both eggs and young, has taught the birds, but not all of them, that safety is in high places. Nests may be built sixty feet up, in a giant gum-tree, but the height varies considerably; and even in these days of Reynard, the fox, many lyre-bird nurseries are situated so low that one may look in at the front door, without the trouble of climbing.

Our quest, on that mid-winter morning, was fruitless, until we had toiled, happily enough, nearly to the head of the gully. Then came the reward of early rising, and a scramble through the bush in drenching weather. A nest of *Menura* was found. On the trunk of a fallen tree-fern (*Dicksonia antarctica*), the structure of sticks and twigs and forest debris was placed, between two slender Christmas-trees (*Prostanthera*) growing out of the log. It was more than double the size of a medicine-ball, roughly round in shape, with a gaping side-entrance, and a platform of twigs, etc., below the "door." The inner nest was composed of bark, dead leaves, mosses and rootlets, all cleverly intermingled, with an admixture of soil. The egg-cavity was warmly lined with lyre-bird feathers. A remarkable bird home, overarched by tree-fern fronds, like giant, green ostrich plumes. Nearby the creek went over sand and pebbles, singing its ripple-song, contented, being free of boulders. For this spot was on a pleasant bend, where rocks had little territory.

A quiet place, in the heart of the gully; a

[1] John Gould, author of the great "Birds of Australia" and other famous bird books.

Close-up view of a Lyre-bird's nest built on the trunk of a fallen tree-fern which forms a bridge over a small stream. Insert is the egg of the Lyre-bird about two-thirds natural size.

bower of ferns, made by Nature for birds, and not for man. We felt, as we were, intruders. Our right to be there was this alone: we had come for the joy of seeing, to gain a little more knowledge of *Menura's* home-life, and to take back to the city pictures, not specimens, for remembrance of a perfect day. All about the tree-ferns grew, some spreading their fronds thirty feet above us; we stood beneath nature's umbrellas, our feet deep in lesser ferns, dead leaves, and living mosses. The foliage showered us as wind shook the tree-tops and swayed drooping fronds; but the rain had ceased, and openings in the forest "roof" were windows of blue sky.

One egg forms the Lyre-bird's clutch—very rarely two have been found in a nest; and this nursery, we had discovered, contained its complement. A large egg, measuring about 2.6 inches in length, it was fairly oval in shape, of rather coarse texture and finely pitted, but glossy and beautiful. The ground color was rich, purple-gray, flaked and spotted with sepia and dark-brown. Coloration varies; and I have seen eggs of *Menura* so dark and so polished their markings were obscure; other specimens, light-purple-slate, with markings pale, too.

The period of incubation is prolonged. An egg in one nest kept under observation was hatched fifty days after it was first seen by the observer—he knew the date of laying. This, in my experience, is very exceptional, the average period being about a month, or a few days more. The young bird develops slowly, and is helpless when several weeks old. It remains in the nursery until it is well-grown. Six or seven weeks after it has broken from the shell it leaves home and learns its first lessons in the school of the wild.

Mating in May or June, the Lyre-birds begin home-making without delay. Mostly, a new nest is constructed each season, though an old one often may provide the foundations. This is the time to hear the male bird at his best; to know him as a songster and a master of mimicry. He seems to be aware of his talents. He is sleek and satisfied; and, borrowing the calls and songs of many other species, he gives them all in one program.

Encores need not be demanded. If you remain hidden and study to be still, *Menura* may continue his performance—from the mound he has formed in seclusion. He sings elsewhere, too; but the mound is his concert platform usually, and on it he capers, rather than dances; nor is it true, as some may believe, that he has a circle of admiring female watchers. His mate, doubtless, is listening-in, nearby, or at a little distance. She may have him in view during the whole performance. But I have never seen hen-birds standing beside a mound, while a male was in possession. Two males, however, may "dance" on the same mound.

The Lyre-bird's repertoire varies; and some males are more accomplished than others. A concert may consist of a dozen to twenty items, or more—from the "guinea-a-week" call of the pilot-bird (*Pycnoptilus floccosus*) to the harsh cries of the black cockatoo (*Calyptorhynchus banksi*). The liquid notes of the gray shrike-thrush (*Colluricincla harmonica*) are perfectly rendered, also the challenging songs of "whistlers" (*Pachycephala*), and the melodies of smaller birds that live in Fernland, or among the forest trees. The calls of a flock of parrots in flight are mimicked cleverly; and the strange call of the whip-bird (*Psophodes crepitans*), which resemble the cracking of a coach-whip, followed by a soft double note. But the "laughing" notes of the kookaburra (*Dacelo gigas*) are not perfectly captured by *Menura:* some he mimics well enough, he stumbles or slurs over others, and a kookaburra listening might "laugh" at his effort.

Bush sounds of human origin are "picked up" by Lyre-birds, whose forte is imitation. Thus, in the neighborhood of a timber mill, I have heard *Menura* mimic the sound made by the circular saw cutting through a log; the sound of an axe ringing on hard wood; a man's whistling; the voice of the mill-siren. Barking of dogs is imitated, too. I quote from a settler's recent letter, written from Gippsland (Victoria), good Lyre-bird country:

"In the scrub at Bulga (a glorious bit of Fernland, and a sanctuary) we heard a Lyre-bird imitate the mill; his performance surpassed anything I had hitherto heard from this incomparable bird. For the mill was a medley of sounds, that you would think one bird could not imitate, more successfully than one man could imitate a choir. Yet our friend in feathers did it, and in no uncertain manner, I assure you."

Young Lyre-birds have strident voices; excepting lung-power, they give no promise, while in the nursery, of becoming fine songsters and mimics. They protest too much when disturbed by an intruder. My first acquaintance with a *Menura* nestling ended in comedy. I was young, inexperienced, and eager. Finding a nest, on a tree-fern bridge over a creek, I hastened to investigate. My hand, thrust into the nest, touched a downy chick, which backed away, and uttered loud, shrill cries that echoed

A fern-gully in Gippsland, Victoria's National Park. A great game sanctuary for native Australian mammals and birds. A haunt of the Lyre-bird.

Lyre-bird (female) carrying food to the nest. Note the large foot with long, powerful claws, which are used in scratching over debris and dissecting rotting logs in the quest for food

among the sticks, it looked grotesque — a very ancient type of bird, aged in infancy!

Since that day of beginnings, I have enjoyed hundreds of outings in Fernland; have photographed Lyre-birds at home, and learned much of their wonderful ways. I have more to learn, whole chapters of the Book of Menura to con—and remember. And, like other naturalists, I have failed to get a passable photograph of the male bird. He is wary; while, in nesting time, his mate accepts man as not necessarily an enemy. It is rare even to surprise a male bird at the nest. While you remain in its vicinity, he will keep away. But the female, learning soon that you are friendly, becomes almost indifferent to your presence. She will fly, or walk, close to the camera, going to and from her nest; will feed the chick while

down the gully. Startled, I lost my footing on the old, mossy trunk, and splashed into the stream. Cold and dripping, and a little wiser, I continued my investigation of *Menura's* home life.

Her baby's cries brought the mother quickly to the nest. She had been foraging not far away. I remained still, watching, and the old bird, after worrying round for a while, resumed her hunting. She scratched over the forest floor, getting here a worm, and there a *Tallitris* "hopper" (a small amphipod, crustacean, that abounds among moist debris, and beneath logs and stones in the gullies). She captured a tiny lizard, and, with beak crammed with tit-bits, my friend — she proved to be confiding — returned to the nest. The chick was fed at the "doorway;" its splay feet astraddle, and big claws clenched

Lyre-bird about five weeks old. The wing feathers are well developed but there is only a hint of the glorious lyre-shaped tail that the adult birds possess.

A remarkable photograph of a female Lyre-bird coming down (almost sliding) a tree trunk with food (worms and insects) in her beak. The nest was about ten feet below the bough on which the bird stands. The long tail often is bent sideways as shown in the photograph, and while brooding it often is held this way. The long, strong claws and feet are clearly shown in the picture.

A young Lyre-bird at the entrance of the nest; a siren-voiced nestling. Hatched in the winter season.

selves which should have the palm.

I have written all this at the close of a winter's day. Tomorrow may find me in the ranges, where I shall see *Menura,* and hear him singing on his mound among the ferns. His mate will come gliding, like a brown shadow, through the gums and the Sassafras trees; through the wattles (*Acacias*) that already are preparing for the golden flower pageant of the year. Our bush is always beautiful. The eucalypts shed their bark in flakes, or long, ragged streamers, but are not bare of leaves in any season. And now, in our parks and gardens, one species of *Acacia* is in bloom.

Presently creeks and rivers will mirror golden clouds of blossom. A snowstorm may spoil the pageant of the hills; and burden the tree-ferns' fronds to breaking. And you look on and take photographs.

A keen cinema photographer, after several seasons of failure, has this year gained partial success. He has films of the female at home, of the young bird being fed, and so forth; and a few lucky exposures will give him a complete moving picture story of *Menura,* the wonderbird.

Cinema work in our dark fern-gullies, in Winter, when even in the open forest the light is poor, tries one's patience and temper. Failures are the rule; and yet it is worth while. We hope that, ere long, Lyre-bird films may be screened in American theatres. And fortune may enable us to send you, also, gramophone records of *Menura's* voice; so that, comparing his art as a mimic, with that of the mockingbird, you may judge for your-

A fledgling Lyre-bird waiting at the mouth of the nest for the parent bird. Nest shown on page 210

with snow-flakes falling on her nest, the mother Lyre-bird may be brooding, in her haunt among the wild mountains. She wins through winter and hard weather. But in summer, when bush fires rage, many gullies are made desolate; the flames sweep through them as though they were vast flues; and creature life pays to the flames a debt it does not owe. *Menura* is among the victims, though many birds escape.

Lyre-birds roost high; in company they spend the night on lofty branches; but the ascent is made from bough to bough, since *Menura* is chiefly arboreal in habits, and does not make sustained flights. Through the ferns it seems to glide, with the long tail *flowing* like plumes in the wind; and from its lodging-place it planes, rather than flies, to the ground.

The author, Charles Barrett, at the nest of a Lyre-bird on a bank of earth in the heart of a tree-fern gully.