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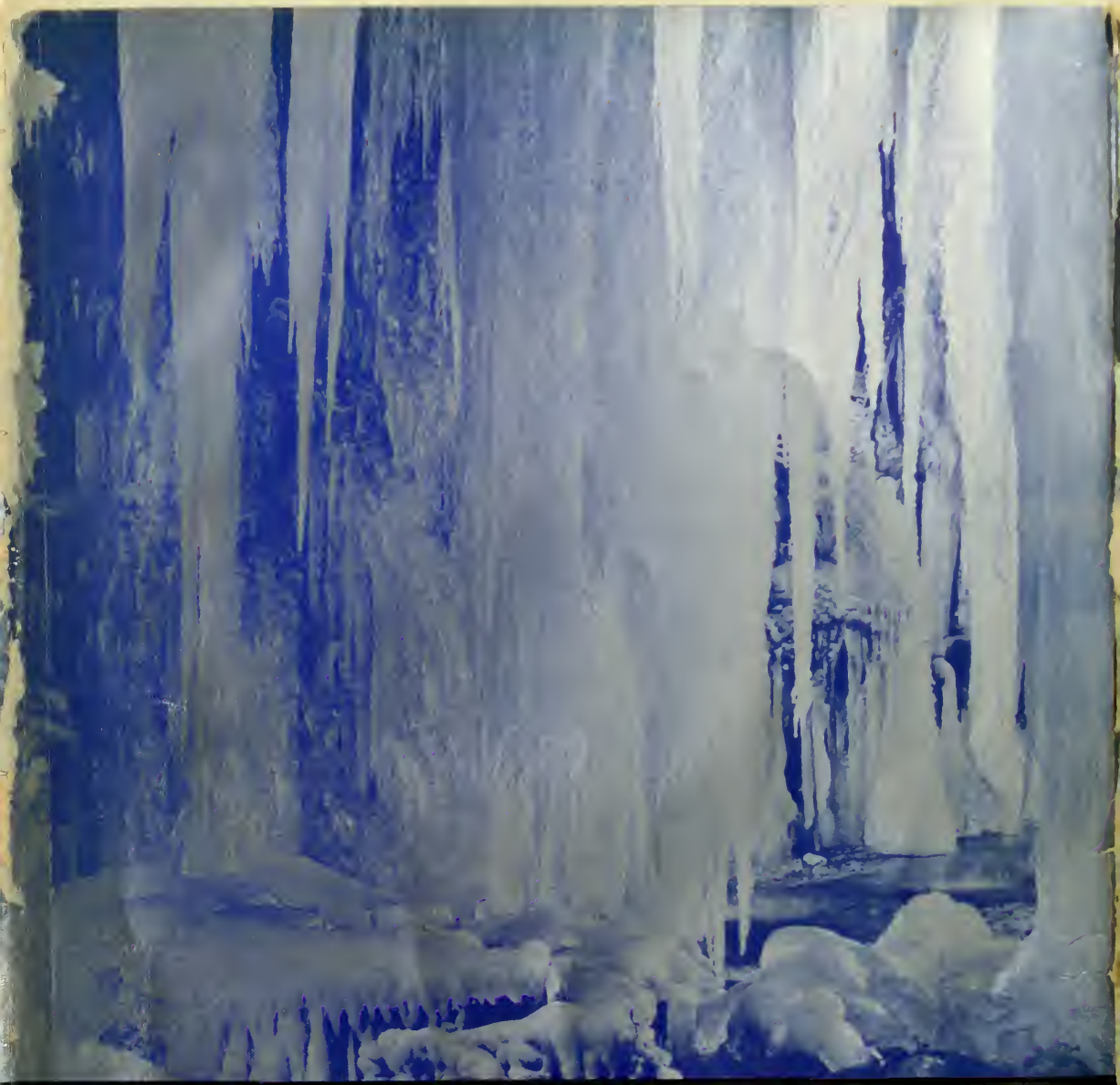

January

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1940

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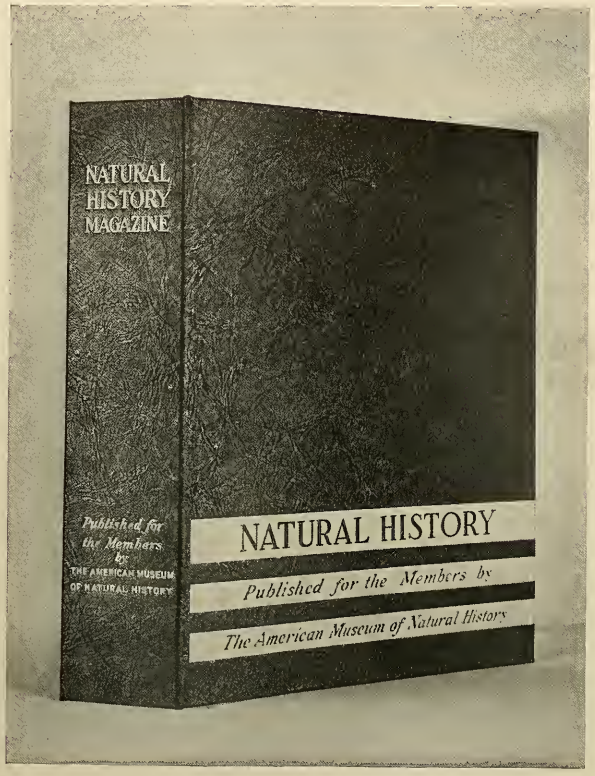

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LETTERS

SIRS:

I send this photograph of an albino snake because its occurrence may be worth recording as the only hognose albino snake ever reported in the United States. It was captured by a farmer in a field near Amherst, New Hampshire, last July; and aside from being an albino, it is one of the most northern records for the species in New England.

Being an amateur naturalist and lover of all wildlife, I purchased the reptile for purposes of study and later released it in its native haunt. Christening it "Snowdrop," we kept the snake in a homemade wooden box with wire screened front. Occasionally the reptile was given milk; it drank copiously of water. Being a hognose, it was hard to feed. Toads were not easily obtainable and it was difficult to find anything that would suit its highly specialized feeding habits.

The snake retired every night by completely concealing itself under the hay, remaining there until nearly eight o'clock in the morning. It was gentle and became quite tame, never once attempting to strike or bite, and was a very enjoyable and interesting pet.

The snake shed its skin while in my possession. It was an interesting process to watch, and after it had cast the old skin, it emerged with jewel-like eyes shining and body and scales glistening white.

I was interested in the possibility of its being recaptured after I released it. I set it loose on September 3rd in a secluded spot twelve miles southwest of Amherst where there was water, a field and woodlands, and plenty of God's country for a snake to live in. Snowdrop emerged from its box and crawled slowly and cautiously toward a nearby clump of ferns, soon disappearing to work out its own destiny. I have not heard from it since.

Milford, N. H. LILLIAN F. NEWTON.

SIRS:

In the latest issue of your magazine, there was an article of absorbing interest on John Lloyd Stephens, the celebrated explorer who, a century ago, called the attention of the world to the now famous Mayan ruins.

Having been a mining engineer for over 30 years and having traveled extensively in Latin America, it happens that I have been interested in John Lloyd Stephens' career, and was, therefore, particularly interested to read Mr. Daoterman's article.

The article states, however, that Mr. Stephens graduated from Harvard at 17, and then went to Law School. As a matter of fact John Lloyd Stephens, a native of this city, graduated from Columbia College as a Bachelor of Arts in 1822 and as a Master of Arts in 1827. In Harvard's Peabody Museum I saw a number of the excellent drawings made by Mr. Catherwood, which fact might possibly account for the mistake in calling him a Harvard graduate, if mistake it be.

It is also implied that John Lloyd Stephens himself estimated that $25,000,000 would be necessary to build the canal connecting the Atlantic and Pacific. This estimate was, I believe, made from Stephens' notes by an expert engineer.

I was particularly pleased to see this interesting article on John Lloyd Stephens because in my opinion he is an important and distinguished New York figure who has never been properly recognized.

New York City. EDMUND A. PRENTIS.

As Mr. Prentis points out, Columbia University deserves the credit for John Lloyd Stephens' academic training; and Stephens, like the wise reconnaissance man he was, sought expert aid in making the estimate for the canal.—ED.

SIRS:

Enclosed is check for three dollars to renew my membership for the coming year.

I have never invested three dollars that brought more genuine returns than the three dollars I invested in an Associate Membership last Fall.

Personally I don't have a chance at the magazine until my wife and two girls have finished seeing it, and, believe me, they enjoy it thoroughly.

I shall be glad to pass your letter (rec'd today) on to a friend. You have "tops" in natural history magazines.

DONALD E. GEIST,
Bellefontaine, Ohio. *Biology Instructor*

P.S.—I especially liked the splendid pictorial map done last Spring, "S. O. S. for a Continent."

SIRS:

. . . I take the opportunity to assure you that your magazine is a favorite in the library of the Institute of Zoology of the University of Montreal.

FATHER OVILA FOURNIER.
Montreal, Canada.

SIRS:

. . . We have a good many magazines. I sometimes wonder why we have them. I never wonder why we have the magazine published by the American Museum. I always read it from cover to cover right away, and then look it over again. The make-up of the magazine is splendid. . . .

Boston, Mass. F. MORTON SMITH.

SIRS:

In the November, 1938, and April, 1939, issues of NATURAL HISTORY you had pictures of the Wilson cattalo taken on the way eastward from Washington. Both photographs were taken by Dr. Clyde

Fisher, the first near St. Louis, the second near Raleigh, N. C.

Enclosed is a photograph of the same animal taken during a stop in Everett, Pa., on May 23, 1939. This time he was traveling westward to his home at Grand View Ranch, Colville, Washington. Mr. and Mrs. Wilson were very much interested in Doctor Fisher's photograph of them and

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The inventor of the telephone, Alexander Graham Bell, in New York, repeated across the continent to San Francisco the first words ever heard over a telephone—"Mr. Watson, come here, I want you"—to the same Thomas A. Watson who had heard them in the garret workshop in Boston in 1876.

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These are measures of progress in the never-ending effort of the Bell System to give faster, clearer, more useful and courteous service to the people of the United States.

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NATURAL HISTORY

The Magazine of the American Museum of Natural History

FREDERICK TRUBEE DAVISON, President — ROY CHAPMAN ANDREWS, SC.D., Director

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An elaborately carved *screen in white jade. In addition to the bat of happiness which flutters between the two dragon heads, there are four bats concealed among the conventionalized cloud pattern that covers the body of the piece*

Familiar Symbols in Jade

The key to the understanding of the exquisite Taoist designs of this art lies in the delightful lore of Old China

By Herbert P. Whitlock

Curator of Gems, American Museum

So closely is Chinese art mixed with Chinese religion that in understanding the art, one also gains insight into the spiritual life of the people.

To use a simple example, the dualism of male and female which runs through much of Chinese religion, folklore, philosophy and science, is a prominent symbolic feature of art. The male element is the *Yang*, positive, bright and beneficial. The female is the *Yin*, negative, dark and evil. These dual forces are expressed in artistic design by the familiar circle divided by an S-shaped line into two symmetrical parts representing the yolk and white of an egg, strongly differentiated.[1]

Here we will acquaint the reader with the symbolic designs in jade, familiar yet rarely understood by the average person, which illustrate so richly the basic truth of Taoism. This is one of the principal religions of China and was founded in about 500 B.C. The abstractions of immortality and happiness as conceived in Taoist terms have greatly enriched Chinese art through all periods subsequent to the Sung dynasty, which ended in 1126.

Much of the myth and legend involving the idea of immortality centers in the Three Isles of the Genii, or the Fortunate Islands of the Eastern Sea. There is a distinct resemblance between these Chinese mythical islands and the much better known Islands of the Blessed of Greek myths. In both cases certain highly privileged individuals enjoyed an earthly paradise in endless bliss.

The Fortunate Islands of Chinese legend were inhabited by immortals and fairies who dwelt in mansions of great magnificence, whose food was the fruit of long life and whose drink consisted of the water from the Fountain of Life which flowed from a rock of jade a thousand *chang* (yards) in height.

Jade carvings of the mountainous scenery that distinguishes these fabulous islands were produced as far back as Ming time (1368-1644 A.D.); and in the last two centuries such strides have been made in the quality and intricacy of Chinese lapidary craftsmanship that these little landscapes in three dimensions are veritable masterpieces. Here one may see paths, houses, caverns, minute figures of the gods and immortals, and the pine trees of long life over which hovers the crane, the Messenger of the Gods.

All AMNH Photos by Kirschner

(Above) The crane, *Messenger of the Gods, is shown intricately carved in fine relief on this girdle plaque in white jade. (Whitlock Collection)*

(Left) Fortunate Island, *in white jade, showing the mountainous scenery that distinguishes these fabulous islands, as well as paths, houses, caverns, and minute figures of the gods and immortals. (Ch'ien Lung period. Drummond Collection)*

FREQUENT IN CHINESE ART, *the bat takes a number of interesting forms*

The butterfly

Because butterflies symbolize immortality in Chinese myth, as in Greek mythology, jade carvings of butterflies were buried with the dead in old China, and no doubt the beautiful white jade butterflies of the Ch'ien Lung period (1736-96) are survivals of a symbol which may have been handed down from Han time, around the time of Christ. In these latter-day representations of the butterfly a tendency toward symbolic stylization has often given to the figure of the butterfly round wings reminiscent of the disks of heaven. Also it has the thorax and abdomen of the cicada, which in the Ming dynasty was a burial amulet; and antennae are developed into conventionalized peach blossoms, stems and leaves, which are symbolic of immortality. The Buddhist symbol, the swastika, often decorates the disk-like wings, and movable buttons similar to those in the center of Buddhist prayer wheels are not uncommon.

The bat

Jade carvings featuring the bat were both numerous and varied throughout the Ching dynasty (1644-1912) down to the present time. The bat symbol saw little use in Chinese carved jade prior to the T'ang dynasty (618-907 A.D.).

Some light is thrown on the traditional lore connected with the bat by the *Pen Ts'ao,* a Chinese herbal *materia medica* printed at the end of the sixteenth century. It is here stated that in certain caverns in the hills bats have been found that were a thousand years old, and whose coats were as white as silver. These bats when eaten ensure long life and good sight. Some of the Chinese names for the bat are "embracing wings," "heavenly rat," "fairy rat," and "night swallow." The bat is said to fly with its head downward because its brain is heavy.

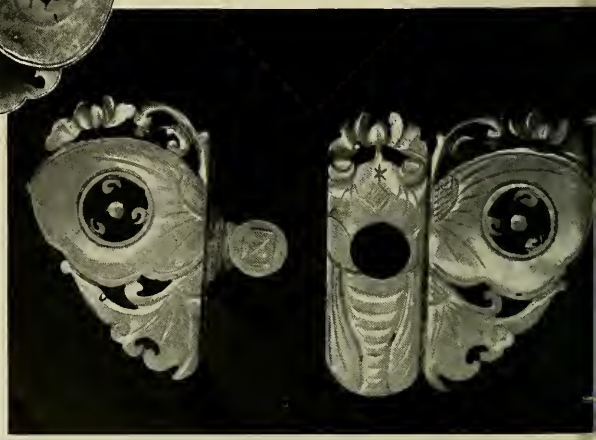
Symbolically, the bat stands for happiness and long life. The Chinese word for happiness is *fu-i,* a word which when pronounced with a slightly different emphasis denotes a bat. In this way the play on the word *fu-i* appeals to the Chinese love for a rebus or pun, which is almost as strong as their love for auspicious symbols. The use of the bat in Chinese carved decorations crowds conventionalization to the verge of ornateness. Some of these highly stylized designs have been said to resemble ornate butterflies.

The design known as the *Wu fu* combines five bats around a central *shou* mark (longevity). This constitutes what is called the "Five Happinesses" or the "Five Blessings"—old age, health, wealth, love of virtue and a natural death.

(Below) EMBLEM OF IMMORTALITY: *jade carvings of the butterfly were buried with the dead. Here the antennae are carved to represent peach blossoms, and the wings display the "golden coin." The body is that of a cicada. (Whitlock Collection)*

(Left) A HIGHLY CONVENTIONALIZED *butterfly whose disk-like wings are pierced with swastika designs. (Whitlock Collection)*

(Below) BUTTERFLY IN BUCKLE FORM. *The buckle is closed by inserting the stud edgewise through the oval hole. (Whitlock Collection)*



Extolled for many virtues, the decorative bat flies with its head down "because its brain is heavy"

Drawings: the Author

The deer

In Chinese symbolism the deer expresses long life inasmuch as it is believed that deer live to incredible age. According to tradition the coat of a deer turns gray at the end of a thousand years. An additional five hundred years leaves the coat white as snow, and when the full lifetime of two thousand years is finished the horns turn backward indicating that the animal has achieved immortality.

Legend also ascribes to the deer alone among four-footed beasts the power of finding the sacred fungus of long life, which fabulous plant is often shown in close proximity to it when carved in jade. Also such carvings often display patterns of stars on the sides of the deer.

Figures of the stag are almost always shown accompanying Shou Hsing, the Star God of Longevity, in the jade carvings depicting him. Wang Mu is also sometimes shown with a stag.

The duck

Pairs of mandarin ducks are said to be inseparable in their attachment for each other; hence the duck, and especially a pair of ducks, is emblematic of conjugal felicity. The use of small jade carvings of ducks as amulets to protect the wearer against death by drowning is founded on the story of a mandarin's daughter who, falling into the Yang-tse-kiang river was miraculously saved by the opportune appearance of a mandarin duck which dived beneath her sinking body and swam with it to the shore.

Jade carvings depicting these birds usually show them with parts of a lotus plant emerging from their bills.

The goose

Like the duck, the wild goose is connected in its symbolism with conjugal bliss. Sharing some of the symbolism of the mythical phoenix, it is essentially a bird embodying the character of the *Yang*, referred to earlier. In its winter flights, which it makes in pairs, it follows the sun to the southward, and because of its habit of mating for the term of its life it symbolizes the married state. Jade figures of the goose are auspicious betrothal presents.

(Right) Three colors *in one piece of jade, carved to show a deer in green jadeite (bottom), a crane in white jadeite (top), and a bat in black chloromelanite (uppermost). (Whitlock Collection)*

(Below) A pair of ducks, *symbolic of conjugal felicity because of their supposed inseparability. As customary with ducks in jade, these are shown amid lotus motifs. (Whitlock Collection)*

(Below) A highly stylized bat *carved in white jade and worn as a pendant. Bats were eaten in Old China for long life and good sight. (Whitlock Collection)*

The crane

Besides enjoying the distinction of being the Messenger of the Gods, the crane is much celebrated in Chinese legend as the bird of long life. Black cranes are reputed to reach the age of 600 years, after which time they drink, but no longer eat.

Carved jade pieces representing the crane usually depict this bird in the neighborhood of a pine tree, another of the many symbols of longevity.

"The Five Poisons"

As early as the Han dynasty Taoism developed a trend toward the treatment of various maladies by means of supernatural medicines, talismans and amulets.

The real founder of this phase of Taoistic teaching was Chang Tao-ling, an alchemist and hermit said to have been born in the year 35 of our era. Paintings of this sage represent him as seated on a tiger beneath whose foot lie crushed the five venomous creatures, the lizard, the snake, the toad, the spider and the centipede. The dried bodies of these deadly creatures are still used as medicines in powdered form in China, and their images collected in an amulet known as "The Five Poisons" are sometimes carved in jade. Such jade pieces, however, are not of a date earlier than the late Ming or early Ching dynasties, about the seventeenth century.

The fox

Many are the legends that have developed in Chinese folklore in which the fox figures. In these he is almost invariably given a supernatural as well as an ominous role. The fact that foxes have sometimes been seen emerging from graveyards and tombs has led to the idea that they are actually the embodiments of souls of the dead and explains their association with ghosts and malevolent spirits. In some legends they figure as coursers on which ghostly beings ride upon their unholy errands.

Other of the fox legends connect them with supernatural treasure, which accounts for the association of a fox with strings of coin to be found in jade carvings of Ching period. Prior to this dynasty carved figures of the fox are very rare.

(Left) Lin Hai, *a student of Taoist magic, disporting with the Three-legged Toad. Believed to be the embodiment of Heng O, who stole one of the pills of immortality, the Three-legged Toad is seen by the Chinese in the luminous disk of the moon. (Drummond Collection)*

(Left) The same Three-legged Toad viewed from below

The three-legged toad

The Chinese profess to see in the luminous disk of the moon the outline of a toad with three legs. This fabulous creature is supposed to exist only on the surface of the moon, and to be the embodiment of Heng O, who stole one of the pills of immortality and for this moral lapse was transformed into a three-legged toad. This legendary connection with the moon definitely places the three-legged toad among the creatures influenced by the *Yin*, the evil element in the dualistic universe. Figures of abnormal reptiles carved in jade are symbolic of the unattainable. Like the moon disks that feature the rabbit associated with the same legend, they are not of great antiquity.

The peach

Among the many Taoist symbols embodying the deep-rooted concept of immortality none is more widely used than the peach. The legendary peaches of immortality grew in the midst of the Western Paradise on the border of the Lake of Gems. They were eaten by the Immortals at the time of the ripening of the fruit, that is once every six thousand years, and by means of that feast these celestial beings renewed their immortality.

Carved semblances of peaches together with peach blossoms in all degrees of conventionalization were very widely used by craftsmen working in jade from Ming time to the present, and examples of the famous symbols are to be found as far back as the Sung dynasty. The blossom of the peach lends itself readily to decoration and is widely used as a conventional motive in jade carvings of the Ching Dynasty.

The fungus

A plant which shares with the peach the Chinese tradition of long life is the Fungus of Immortality, which was supposed to grow only on the sacred mountain Hua Shan in the province of Shensi. Its appearance was said to predict the advent to the throne of a virtuous emperor; also its seeds were supposed to furnish food for the immortals and genii of Taoism.

The contorted and involved shape of this miraculous plant lends itself well to carved designs, and its use in this connection was very popular with jade lapidaries of the late periods.

The bamboo

As an emblem of longevity, the bamboo is much used in Chinese glyptic design in jade, the jointed stems and pointed leaves being used with considerable effect in carving of the Ching period. The bamboo combined with the pine and the prunus (plum) is sometimes used in jade carvings indicating jointly the "Three Friends," Buddha, Confucius and Lao Tzu, a Chinese philosopher of about the sixth century B.C.

"The Eight Treasures"

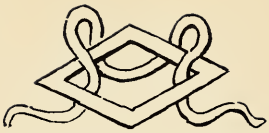
The eight ordinary symbols of Taoism should not be confused with the Buddhist auspicious signs, eight in number, which were found in the impression of Buddha's foot. "The Eight Treasures" comprise the Dragon Pearl, the Coin, the Lozenge, the Mirror, the Stone Chime, the Books, the Rhinoceros Horns and the Artemisia Leaf. As carved in jade of recent period they are often shown entwined with ornamental ribbons or fillets which were supposed to lend added efficacy to the charms they represented.

(Below) PEACH BLOSSOMS *decorate this "stone chime" which "rings" when struck. (Whitlock Collection)*

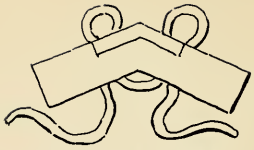
(Below) THE FUNGUS OF IMMORTALITY, *whose seeds nourished the immortals, carved in brownish jade. (Whitlock Collection)*

(Below) "THE THREE FRIENDS": *the bamboo, the pine, and the prunus blossom; signifying Buddha, Confucius, Lao Tzu. (Whitlock Collection)*

THE GOLDEN COIN



THE LOZENGE



THE STONE CHIME

The dragon pearl

There is a Hindu legend which, in recounting the various birth fables ascribed to the pearl, speaks of a pearl of the clouds, utterly inaccessible to man, and possessed by the gods alone. It is quite possible that this story may have reached China with other Brahminical and Buddhistic myths and was associated by the Chinese with the dragons of the air. In late period designs, especially in elaborately carved jade screens, we find two or more dragons contending for the precious pearl amid clouds which partly conceal it.

The coin

The familiar "cash" coins, round with a square hole in the center, have been in use in China since the Han period, around the time of Christ. Their adoption as symbols of wealth, or more broadly prosperity, rests upon a perfectly obvious predication.

As carved motives in jade, they are frequently combined with the happiness bat, either singly or in groups of two or more. A design involving nine coins is sometimes referred to as the "Nine Prosperities," in which case the inscriptions of the nine coins of the group indicate peace, abundant harvest, good luck, plentiful blessings, felicitous times, eminent rank, auspicious omens continued wealth and increasing fortune.

The lozenge

As one of "The Eight Treasures" the lozenge is typical represented as an open diamond-shaped frame, through which a fillet or ribbon is draped. This design is fairly common as applied to embroidery textiles and ceramics, and is sometimes found upon carved jade inclosing a swastika. A common variant often encountered in modern jade carvings consists of *two* lozenges having their ends interlocked, and showing rounded, hollow enlargements at the angles. This is said to represent an ancient jade musical instrument, and Williams[2] refers to it as a head ornament, and states that it is supposed to symbolize victory.

Another interpretation of the meaning of this double Lozenge is a representation of the "Two Bushels", and counts the enlarged corners (exclusive of the one in the center of the first diamond) as seven stars, counting either way.

The stone chime

The Chinese have recognized the attractive musical note emitted from jade when struck since times of great antiquity. One of their oldest musical instrument of percussion consisted of a thin plate of jade shaped to resemble a carpenter's square. This sonorous stone from its shape typified a life of justice and integrity, and also symbolized prosperity. Originally

(Left) A WHITE JADE CARVING *representing the nine coins symbolizing "The Nine Prosperities." (Whitlock Collection)*

(Right) A WHITE JADE *pendant that shows the stone chime surmounting a pair of fishes (a Buddhist symbol). (Whitlock Collection)*

THE RHINOCEROS' HORNS

THE ARTEMISIA LEAVES

the stone chime comprised sixteen such pieces, uniform in lateral size but of varying thickness to constitute a scale, and suspended in two rows in a wooden frame.

As a decorative symbol the sonorous stone is much used on carved jade of the Ching period, and as so represented the angle between the two arms is considerably more open than the right angle of the ancient form. Also the two ends are frequently carved in rolled designs suggestive of the conventionalized fungus of immortality.

The rhinoceros horns

The symbolism of a pair of rhinoceros horns is variously given as indicating happiness or prosperity. The latter interpretation seems to rest upon the resemblance between them and the familiar horn of plenty of Western usage. As a decorative motive in carved jade, this symbol is rarely used.

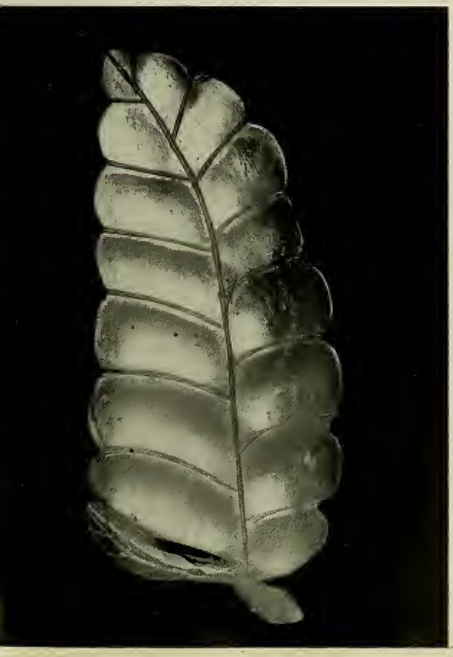
The artemisia leaf

This medicinal plant, whose leaf is used among the Chinese as a symbol of healing, is frequently represented in the small jade carvings of late period. Often these carvings take the form of a single leaf, but it is by no means uncommon to encounter the addition of a small recumbent figure. Such a puppet is in reality a physician's manikin, wherewith the Chinese medico arrives at his diagnosis. He simply hands the image of the reclining lady to the actual lady patient, who places her finger on the portion of the carved anatomy that corresponds to the source of the pain, and the man of medicine knows exactly, or perhaps more or less, the nature of her ailment. No doubt the lack of realism in the anatomy of these lay figures is a concession to the feeling of feminine delicacy on the part of the Chinese patient.

Among "The Eight Treasures" the Mirror and the Books are very seldom represented in the jade carvings even of the late periods. As a symbol, the Mirror stands for unbroken wedded happiness. The association of the Book with literary attainments is a perfectly obvious one.

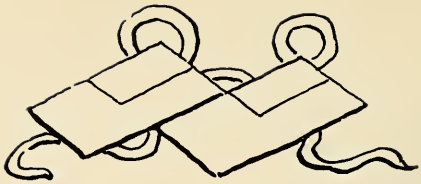
The joo-i scepter

Many theories have been advanced to account for the shape, and to explain the original use which was made of this object in old China. It has been said by some authorities that its shape was derived from that of the Fungus of Immortality symbol. Others, following the ingenious theory of Dame Una Pope-Hennessy, see in the form of the scepter, when viewed sideways, the outline of the Chinese constellation of the dragon. Still others regard it as a survival of a primitive divining rod. A Chinese archaeologist of

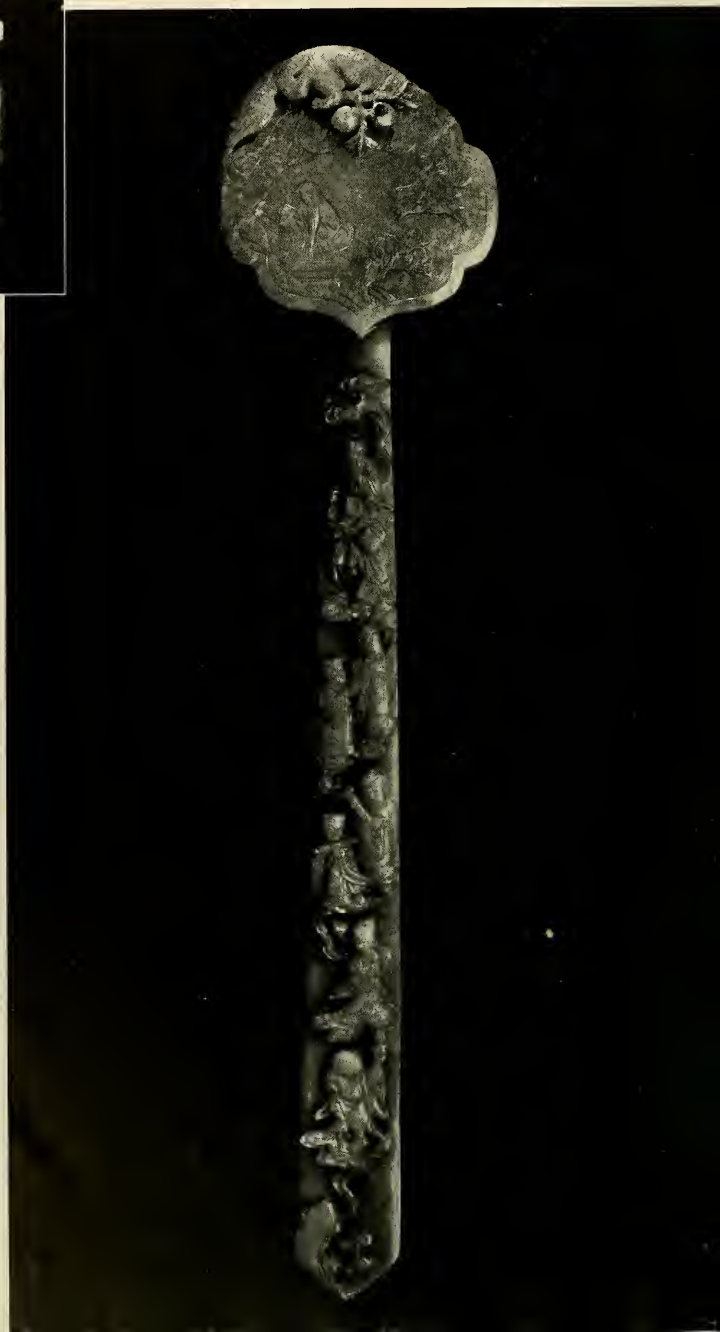


(Left) THE ARTEMISIA LEAF *in white jade. Supposed to possess medicinal qualities, this leaf is used among the Chinese as a symbol of healing. (Whitlock Collection)*

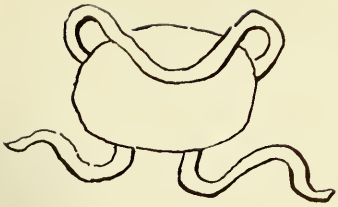
(Right) "THE RECLINING LADY" *is often shown in connection with the artemisia leaf, as in this piece, where she serves as a physician's manikin on whom the lady patient indicates the portion of her anatomy that is ailing. (Whitlock Collection)*



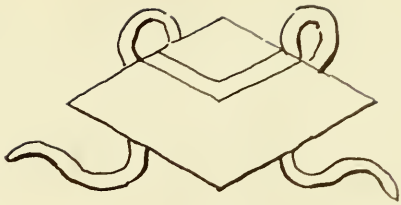
(Above) TWO JOO-I SCEPTERS *decorate this tablet of white jade, thus making it a token of friendship and happy augury. (Whitlock Collection)*



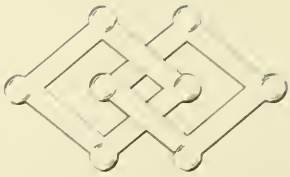
THE FINELY CARVED JOO-I *scepter in white jade shown at right is a distinguished example of this ancient Chinese symbol, whose origin and meaning are somewhat obscure. Variously explained as a scepter, a divining rod, a weapon of self-defense, and a talisman, its broad magical utility is perhaps best expressed in the literal translation of its name: "In accordance with your wish." On the handle of this example parade the eight immortals of the Taoist philosophy. (Drummond Collection)*



THE DRAGON PEARL



THE MIRROR



THE DOUBLE BUSHEL

Drawings by the Author

the thirteenth century is quoted as saying that it was used to "point the way and to guard against the unexpected," that is, for gesticulation and for self-defence, as a form of blunt sword.

The present use of the *joo-i* scepter in Chinese life is a purely ceremonial one. It is presented as an auspicious token of friendship, as a symbol of happy augury. Its very name signifies "in accordance with your wish."

Because of this custom of presenting the "good wish scepter" to people of distinction, including the Emperor, *joo-i* scepters were often carved completely from jade, as in the example shown here from the Drummond Collection. When made from wood, they were set with oval plaques of jade at both ends and in the middle. But the happy symbolism of the *joo-i* scepter does not stop here, because we find them carved in decorative designs on the small jade girdle pendants of the Ch'ien Lung period. As so used they are almost invariably placed in crossed or opposite pairs to give balance to the design, and combined with bats, peach blossoms and other auspicious symbols.

It is impossible to contemplate the rich and varied symbolism of Chinese Taoism without being impressed with the abundance of auspicious wishes expressed in it.

So it is eminently fitting that NATURAL HISTORY Magazine should extend to its readers in this first issue of 1940, its wishes for long life, happiness, success, wealth and all the other fortunate tokens expressed and depicted on these pages.

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[1]For the use of this symbol and others not discussed in the present article, see Herbert P. Whitlock, "Chinese Design," NATURAL HISTORY Magazine, January, 1937.

[2] C. A. S. Williams, *Outlines of Chinese Symbolism* (1931), p. 223.

MEET MISTER

By ARTHUR F. MCBRIDE *Curator, Marine Studios*

Introducing the readers of NATURAL HISTORY to one of their most "human" deep-sea relatives. His astonishing habits, observed at Florida's Marine Studios, reveal an appealing and playful water mammal who remembers his friends and shows a strong propensity to jealousy and grief.

DOCILE *as a pet dog, the porpoise does not snap his jaws in taking food. Merely enough pressure is exerted to hold the fish until the animal falls back into the water to swallow it. Visitors have been permitted to feed the leaping porpoises*

Photo by Wm. F. Gerecke

PORPOISE

AIR VIEW *of Marine Studios, Florida, the world's largest aquaria tanks*

Photo by Wm. F. Gerecke

ROMANCE of the sea! What a fascination lies in ragged reefs, crashing combers, rusty freighters and all the flotsam that finds its way from 'Frisco to Rangoon—New Bedford to Singapore. Yet of all the tall tales recounted by sea-going men perhaps none were so imaginative as those about whales, porpoises and dolphins. While scientists, working almost entirely from dead bodies, laboriously acquired a great deal of information upon the structure, modification and special adaptations of many species of these mammals, the popular concept has to a great extent remained a mass of fanciful legends.

Of course, the surging roll of a porpoise as it breaks water to breathe is a familiar sight in our own coastal waters as well as on the high seas. But the bulk of a porpoise's life, like the bulk of an iceberg, lies principally beneath the surface of the water. And, until March, 1938, no one had ever been able to study accurately this sub-surface existence. At this time the first porpoises were introduced into the newly-built circular oceanarium at Marine Studios, Marineland, Florida, to begin a life of captivity under close observation.

What are the Marine Studios? What is the difference between this enterprise and any other aquaria? The difference lies in the fact that at Marine Studios marine life is not segregated by species but placed to-

"PORTHOLES" *below water level give the visitor the nearest thing to a descent in diving helmet. All captive porpoises have learned to take food from the diver*

Photo by Wm. F. Gerecke

gether as it exists in the open sea. We therefore find in one tank sharks swimming side by side with a school of jacks, and a six-foot green moray coiled under the same rock that is home to a six-inch angel fish.

Assume for a moment that we are guests for the day at Marineland. As we approach the giant tanks, we are astounded at the natural beauty of the place. The tanks themselves are built along the ocean front and to the east extends the broad expanse of the blue Atlantic. To the west the ground rises in lump contours of sand dunes and shell mounds, and rolls away to the Intra-Coastal Waterway shimmering in the bright Florida sunlight. Countless palms wave a friendly greeting and the white of the sand dunes is softened by cactus, yucca and seagrape.

We approach the south end of the gigantic tanks and are directed to the main entrance. As we step into the lower corridor, soft blue lights lead us from porthole to porthole; and through these windows we gaze in awe at the fascinating, colorful undersea world. The blue-green waters, pumped from the ocean at the rate of five million gallons per day, are iridescent and clear. The floor of the mammoth oceanarium is covered with sand, sea shells and plumes. A seven-ton coral reef affords protection for the smaller specimens. A 300-pound turtle lumbers lazily over the coral reef, and great schools of shiny bumper fish follow in his path with the hopeful expectancy of finding a few scraps of food the big fellow might leave behind. From the stern of a shipwreck, the long sinewy shape of a shark electrifies the scene, and many of the smaller fish scuttle for cover. A huge ray grotesquely flaps his way over the sea fans while a spotted moray suspiciously eyes his passage from a safe sanctum in the coral.

The 200 glass portholes, averaging 18 x 24 inches, encased in the steel tank walls, stand out like brightly lighted stages in the semi-dark corridors. Sitting in front of a porthole, the visitor is shielded from inclement weather and outside distractions as the immense life of the ocean floor unfolds before him.

In their large size also, the oceanariums are unique. The circular tank, the one in which the porpoises live, is 75 feet in diameter and twelve feet deep. The other is roughly rectangular and has a length of 100 feet, width of 40 feet and a maximum depth of 18 feet. Connecting the two, and serving as a quarantine for new specimens, is the shallow receiving tank.

The design of this structure was conditioned by the three functions it was to perform. First, to offer the public the opportunity to observe the complexities of life under the surface of the sea. Second, to offer the motion picture industry the facilities for filming underwater action against an authentic background. Third, and most significant, to offer the scientific world the opportunity for study and investigation into the biological problems for which the facilities of the institution are most adequately fitted.

To the visitors at Marine Studios, the bottle-nosed dolphin, commonly known as porpoise in American waters, is of greatest interest. The first view of the large gray animals, from underwater, completely transforms previous concepts of them.

Battleship gray with its underbody a dull white, the porpoise embodies Nature's most streamlining effects. Observing them through the portholes, the visitor is amazed at the grace and speed which the porpoise attains. The tail of the porpoise, unlike that of any fish, beats up and down and by this perpendicular motion, the supple flow of muscular effort throughout the entire body enables the porpoise to attain tremendous bursts of speed. Frequently after the animal has achieved momentum he will arch his back and glide across the tank; and often during courtship, the animal will barrel roll for some 20 to 30 feet.

Porpoises, of course, are primarily fish eaters, and in coastal Florida waters they feed principally on mullet. This readily obtained fish is fed to the porpoises here, and each adult eats at least 20 pounds daily.

Two opportunities, to date, have been offered to observe the nursing and weaning of a young porpoise. The two originally captured in March, 1938, proved to be mother and daughter; the young one beginning to nurse at once. Throughout the day and night the baby took nourishment at 15 to 30 minute intervals.

When nursing, the young porpoise holds the end of its snout for about five seconds over the inverted nipple, which lies hidden in a fold in the blubber. By contraction of specialized muscles of the abdomen the parent forces the milk, which has collected in sinuses running lengthwise through the mammary tissue, into the mouth of the offspring. The whole operation can take place quickly, an obvious necessity, because young porpoises very rarely remain submerged, at least here in the oceanariums, for more than 30 seconds. Young nursing manatees, on the other hand, remain underwater for ten minutes and suckle in typical mammalian manner.

Three weeks after capture, the young one began grasping fish in her mouth, and after playing with the fish for a few moments would drop it and pick up another. Once in the fourth week the young one was observed to swallow at least one fish.

The following day the baby was in distress. The dull eyes and listless form bespoke complete misery. Frequently the young porpoise vomited, and each time the attendant parent rubbed the stomach of the little one steadily with her snout. By late afternoon the attack passed, leaving the young one completely fatigued.

All during this period the baby was receiving nourishment from her parent. In the eleventh week, however, she again swallowed small mullet. During the next three weeks the amount of fish consumed rose to about ten pounds. The young one, however, frequently attempted to nurse until the fourteenth week.

The second nursing porpoise to be studied in the tanks was captured with her mother in July, 1939. About a month after capture, the female appeared to go dry. The young one, however, made frequent attempts to obtain milk. For a ten-day period the little one went apparently without nourishment and lost much weight. Finally she started eating a few fish a day, but swallowed them with considerable effort. Within a week she was eating up to ten pounds per day and was competing successfully with the adult porpoises. At this writing, she is healthy and filling out rapidly.

The portion of the brain devoted to receiving sensations of sound, we learn, is particularly well developed in the porpoise. It is extremely interesting, therefore, to watch the behavior of an animal whose principal concept of his surroundings comes to him through his auditory apparatus.

The auditory apparatus has been considerably modified in the case of these sea-going mammals. No outer ear is visible on the head of the porpoise. If we look closely, however, in the region a few inches behind and lower than the eye, we notice an almost invisible opening, the rudiment of the auditory canal. In the case of the animal we are watching, it is scarcely large enough to permit the entrance of a toothpick. Water is an excellent conductor of sound. This closure of the auditory canal, therefore, does not impair the animal's sense of hearing, as sound vibrations are carried directly to the bones of the skull. The porpoise is interested principally in the sounds transmitted through water, and has been able to close his external auditory canal without endangering his survival.

The importance that this sense of hearing plays in feeding has been particularly interesting. The first porpoise to be captured and placed in the tanks here in March, 1938, showed no interest whatsoever in dead fish that were presented to him. Accidentally, however, it was discovered that if the fish hit the water broadside, with a splash, it was immediately taken by the porpoise. Thereafter, fish were slapped on the surface several times and were then thrown to the porpoise in such a manner that they landed broadside on the water. The significance of this discovery is interesting because we know that here in the murky inland waters of the Florida coast, mullet frequently leap clear of the water to land on the surface with a splash. The possibility is offered, therefore, that the porpoise, by their sense of hearing, locate the schools of mullet.

The importance that sound plays in the life of the porpoise has led to much discussion about the means of communication among whales, dolphins, etc. Considerable references have been made in literature to the cries or calls uttered by these sea-going mammals particularly, when harpooned or captured. One of the first discoveries made at Marine Studios with captive porpoises was that the animals are capable of sound. A sharp whistling sound was clearly evident in the corridors surrounding the circular tank after the first bottle-nosed dolphin was introduced. The sound was soon noted to be caused by the escape of air from the blowhole. Subsequent observations led to the assumption that the sharp whistling sound made by porpoises was possibly similar in origin.

During the first week or two of captivity all of the specimens whistled constantly and swam about the tank nervously. After they became acclimated, however, the whistling was heard less frequently and apparently served as a method of communication. The animals made this sound less frequently during the daylight than at night.

Apparently the animals used variations in this whistling sound to indicate different emotional states. Usually when one or several of the animals were chasing a live fish, they would be whistling excitedly. When any disturbing object, such as a net, was present, this was also true. This sound was transmitted well through water and was heard distinctly in the corridors surrounding our tanks above the scuffling of feet and the chatter of voices.

When it was necessary to move two porpoises, the original mother and daughter, from the rectangular tank into the circular one, a very clear example of the function of the sound was obtained. The parent was netted first and moved through the shallow connecting tank into the circular. The water level was then lowered in order to catch the young one. The two animals remained in their respective tanks close to the wire mesh gates that separated them from each other, the young one whistling madly and the parent frequently answering her. As soon as the water level in the two tanks dropped low enough, so that the connecting tank was dry, and the watery, and therefore sound-conducting connection between the two tanks was severed, the parent left her position at the gate and swam about the whole tank, even showing some interest in chasing live fish. The young one persisted in whistling as loudly as ever although the parent never whistled again after she was unable to hear the young one. Within a short time the young one was captured and placed in the tank with its parent, where they joyfully renewed their life together.

Photo by Wm. F. Gerecke

(Left) THE CONCRETE SHELL *surrounding the steel tanks encloses observation corridors. Stairways lead to a top deck from which the surface of the tanks can be viewed. Flocks of pelicans pass overhead continually and egrets dot the marsh expanses to the west*

Photo by Mrs. C. V. Whitney

(Right) A NEWLY-CAPTURED *porpoise in the well of the collecting boat* Porpoise. *The steel doors at the distant end of the well open to the sea through the stern making it possible to bring large specimens in under water. The pad and sling at the left will be placed under the porpoise preparatory to hoisting*

Anyone who has swum under water knows how poorly we can see beneath the surface. How then can the porpoises and whales, which were once land creatures, pursue their submarine existence?

A frequently observed fact, has been that whales, such as the killer, raise their heads out of water at the edge of ice floes, apparently looking for prey. The captive dolphins at Marine Studios frequently peer, head out of water, and undoubtedly perceive with some degree of definition, moving objects at a distance of at least 50 feet.

Whenever anyone walks out on the feeding platform, whether carrying food or not, all the porpoises gather in anticipation, raising half their bodies out of water as they follow the movements of the human. One of our young porpoises, which became very tame, was a particularly keen observer of above water activity. While this young one was resting at the surface, its attention could be attracted by a hand waving at a distance of 50 feet. The animal would come racing across the tank and leap out of water to investigate the waving object.

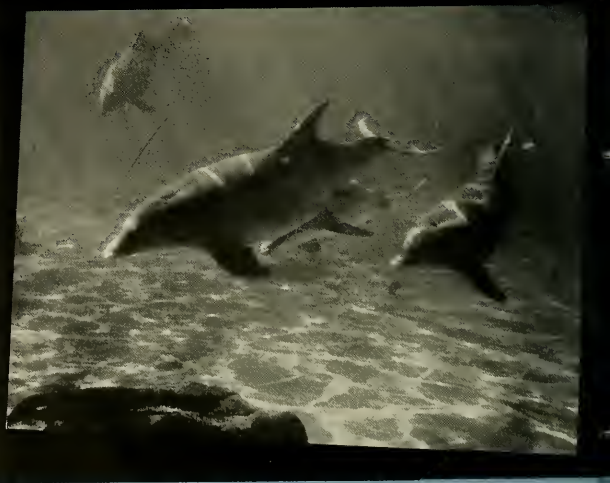
All porpoises after being acclimated to captivity will follow a fish thrown through the air 20 feet

(Below) YOUNG PORPOISE *about to catch a live fish while "Ma" looks on approvingly. When live fish are introduced the animals work together and herd the school against the wall where they can be more easily caught*

Photo by Wm. F. Gerecke

THE SINGLE CLOSED BLOWHOLE *shows up prominently on the heads of these porpoises. The large animal in the center is an adult female, and her young nursing offspring follows in typical manner close behind*

Photo by Mrs. C. V. Whitney



COMFORTABLY CRADLED *in canvas, the porpoise has been transported from the dock to the oceanarium in a special truck. A hoist then lifts the quiescent animal up to the receiving tank. Being an air-breathing mammal the porpoise can be kept out of water for long periods*

Photo by Mrs. C. V. Whitney

above the water, by swimming on their sides, heads out of water, and intently watching the fish with the exposed eye. Occasionally they catch the fish in their mouths, but usually only arrive in the general region in which the fish lands. That they recognize the flying object as a fish is improbable, because the tamer ones will leap just as high out of water to take the keeper's empty hand as they will to take a fish. After a few unrewarded leaps, however, they will refuse to jump until the reward is again given.

Underwater it is more difficult to determine the extent of the bottle-nosed dolphin's vision. Because the water in the tank is of exceptional clarity, the observer is usually able to recognize objects on the far side of the tank, 75 feet away. It would appear from observations that the porpoise can see almost across the tank, but no direct evidence bears this out. Due to the fact that the turbidity of the waters near Marineland is usually twenty-five times greater than that in the tanks, the possibilities for extended vision in nature are considerably less than they are for animals in captivity.

All mammals require sleep in order to live and it is therefore not surprising to find that the porpoises spend definite periods throughout the day and night completely relaxed. The animals, during these periods of relaxation, always remain motionless at the surface, the top portion of the head, including the blowhole, exposed to the air. The tail portion of the body, having less displacement than the forward part, dangles beneath the surface.

Eyelids of the animals close during this time, but periodically they open half-way for a second or two, doubtless on the lookout for danger. Usually the eyes do not remain closed for longer than 15 seconds at a time, although not infrequently they may be closed for as long as 30 seconds.

Breathing during this period of sleep is steady and to our way of thinking extremely slow, averaging about 30 seconds between breaths. During normal swimming activity the rate is slightly higher.

A YOUNG PORPOISE *at Marine Studios takes a mullet near the surface. The light scattered by the rippled surface completely breaks up the form of the animal and at a distance renders him quite inconspicuous. The small silvery fish are bumpers. They follow porpoises and turtles in the oceanarium to feed on scraps of food*

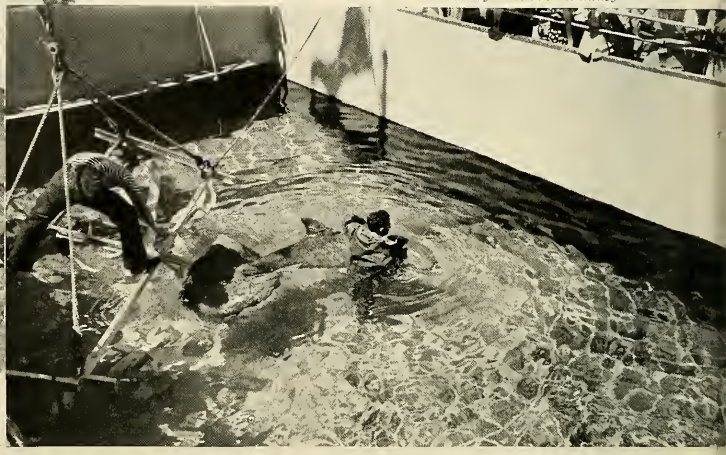
Photo by Wm. F. Gerecke

Photo by Mrs. C. V. Whitney

(Left) THE NEW ARRIVAL *is gently lowered into the receiving tank. During this handling, the mammals remain remarkably quiet and suffer no injuries to their sensitive skins*

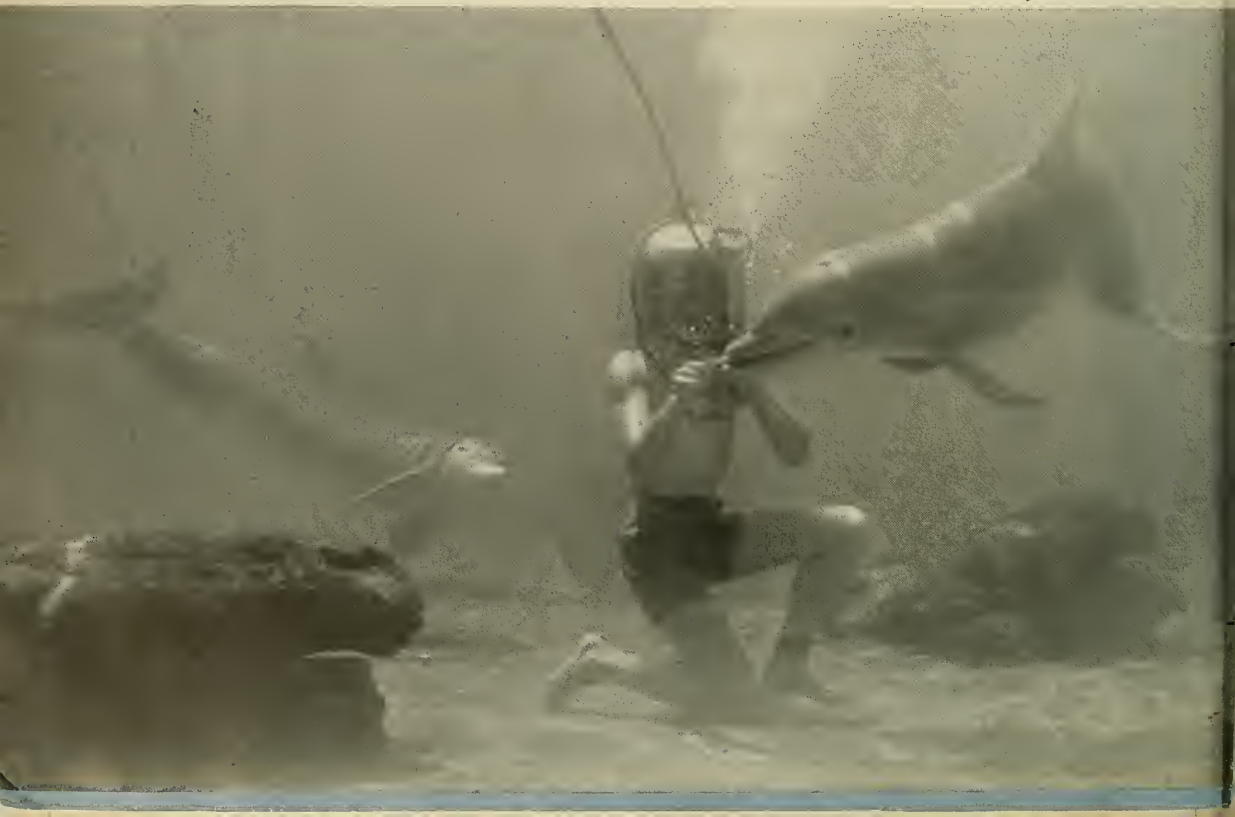
(Below) AN ATTENDANT *assists the animal from the canvas sling. New arrivals are kept in this tank for weeks, where they lose fear of man and feed freely. They are then better able to compete with older residents in the large tank*

Photo by Mrs. C. V. Whitney



THIS PHOTOGRAPH *was taken when the original mother and daughter were being trained. A few moments later, the adult took the author's right foot in her mouth and started off. As soon as she realized her mistake, however, the foot was released with scarcely a scratch*

Photo by Wm. F. Gerecke



Apparently the females float more efficiently than the males, and in the case of all female specimens, the tops of the heads are almost continuously exposed to the air. The males usually float several feet below the surface, and, by means of a steady but very slow up and down motion of the tail, maintain their position.

Young porpoises have never relaxed as completely as the adults, particularly the tame young one. This animal, while sleeping alongside its mother, would frequently become restless and attempt to arouse its parent by butting. Failing to disturb the mother's slumber, the young one would look elsewhere for entertainment. A red snapper living precariously in a rock cave on the bottom of the oceanarium was plagued constantly by the young porpoise. With nose pointed downward and body vertical, the snout of the porpoise would probe first the front door and then the back door of the snapper's cave. The fact that the fish was twenty times too bulky for its throat never dampened the porpoise's enthusiasm over the game.

In October, 1938, two very young porpoises were captured and placed in the circular tank. One of these, a female, was six feet in length and the other, a male, was six and a half feet. The two new ones were persecuted immediately by the adult female and during the first two days she frequently bit them. After the third day, the new ones were able to procure food when it was thrown to them at the distant side of the tank. The adult, however, never did tolerate their presence. The new ones had to remain well out of her reach. They, therefore, never had any opportunity to rest, and even when the adult was sleeping, they would swim about nervously. The wounds caused by the bites of the adult porpoise never healed, and, although they ate readily, their health gradually failed. Four weeks after their arrival, the young female died, and four days later the male followed her. Although we have found that even superficial wounds heal only with difficulty in the porpoises, it is difficult to believe that the deaths of the two young ones were due entirely to these infections. The fact that they never relaxed for an instant during the month they were in the tanks is very possible the principal cause of death and offers an indication of the importance of sleep to these mammals.

Few disturbances in the tanks interrupt the sleeping periods of the porpoises that have been well acclimated to captivity. Frequently at night it is necessary to lower the water part way in the tank and flood the area with artificial light in order to carry out cleaning operations. After a short time, the porpoises accept these disturbances and continue with their sleeping activity as completely as if no disturbances existed.

All of our observations to date tend to show that there is a definite social order in the porpoise school. As no group of porpoises has remained intact for any period of time longer than a few months, it is difficult

RECENT ARRIVALS: *another mother and daughter. The young one is usually found following right behind her parent. The mammary gland is located at a point just above the head of the young one, and while the parent swims slowly the young one turns on her side and nurses in approximately this position*

Photo by J. Carter Harris

to have a complete understanding of the position of the various animals in the social order.

We have found that new arrivals in the tank, if smaller, were chased and frequently bitten by the older residents. As mentioned previously, in October, 1938, two young animals were introduced and were never completely tolerated by the adult female. At that time the adult female and young offspring were the only residents in the tanks. In January, 1939, two adult male porpoises were introduced into the tank after the adult female had lost her young one. From the beginning there was no question that the larger of these two males was the dominant one.

Courtship activity began immediately, and although the smaller male was definitely subordinated to the larger, it in no way lessened his activity during the courtship period. Less than two weeks after the two males were introduced, a smaller male, seven and one-half feet in length, was captured. The two large ones immediately persecuted him and during the first few days he was bitten several times. Because of his agility, however, he was able to avoid the two larger males.

Within a few weeks, he was more or less accepted by the other porpoises, and was milling around the feeding attendant's platform during feeding time.

Photo by Wm. F. Gerecke

THE PORPOISES *at Marine Studios are curious about activity on the top deck and frequently raise their heads above water. While in this position they can be attracted by a waving hand or other moving object, and the visitor can induce the porpoises to leap out of the water for a photograph. They also gather in this manner before each feeding*

THIS TRIO, *an adult and a young bottle-nosed dolphin and one spotted dolphin, were captured at about the same time and were kept together in the receiving tank for a short training period. When they were placed in the circular oceanarium, the spotted persisted in following the other two for several days in spite of protests on the part of the adult bottle-nosed*

Photo by Mrs. C. V. Whitney

This small male never indulged in any of the courtship displays of the larger males, and as long as he remained at a distant side of the tank, he was not bothered by them. Even during the sleeping periods the young male was careful to remain on the side of the tank opposite from the other two.

The principal form of intimidation was a loud snapping of the jaws which, when a dominant animal did it, was almost always sufficient to scare the submissive one away. Frequently all that was necessary was the assumption of a posture like that taken by a porpoise when preparing to get under way quickly.

Because the two males were captured together, apparently their social relationship had been determined previously. One was about nine feet in length, the other eight and one-half, and there could be little question that during the feeding and courtship activity the larger one was the more dominant. There was practically no fighting between the two, and, aside from occasional jaw-snapping on the part of the larger, the two were very peaceable. During the court-

(Below) THE EVER PRESENT PORPOISE SMILE. *This is the first "baby," whose antics endeared her to staff and visitors alike.*

One young porpoise outdid the Dog in the Manger, whose spiteful snapping prevented the cattle from feeding on the hay he could not eat. The porpoise day after day jealously took eel grass from a manatee which was receiving attention, until, stuffed with indigestible food, it died. The bereaved parent held its lifeless body at the surface for some time, presumably to let the young one breathe if still able

Photo by Wm. F. Gerecke

(Below) FOUR *adult porpoises schooling. Any novel disturbance in the tank causes all of the animals to band together*

Photo by Mrs. C. V. Whitney

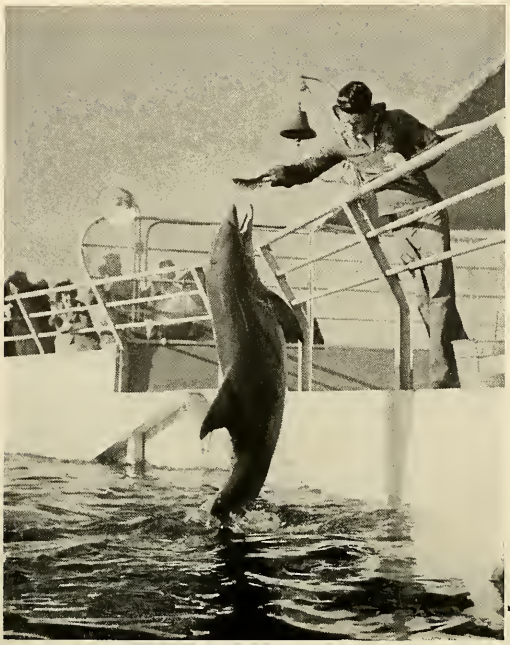


Photo by Wm. F. Gerecke

YOUNG PORPOISE *leaping for food. This animal has been known to clear the water completely when particularly energetic*

ship activity neither of the males would permit the other to leave for even a few seconds.

In February the smaller of the two large males was removed from the tank and transported by means of our tank truck to Tampa. It was exhibited there under the auspices of the State Conservation Department in a concrete tank for three weeks. After being brought back by truck, it was again placed in the circular tank. When the animal was released into the tank, the greatest amount of excitement on the part of the larger male was exhibited. No doubt could exist that the two recognized each other, and for several hours they swam side by side rushing frenziedly through the water, and on several occasions they leaped completely out of the water. For several days, the two males were inseparable and neither paid any attention to the female.

From our limited experience with the bottle-nosed dolphin, we find it difficult to ascribe any definite mating season for the species. Courtship was first observed when the first two males, previously mentioned, were placed in the tank with the lone adult female. Courtship activity began immediately with several forms of display by the males. Both would come gliding across the tank, usually swimming upside down, fre-

(Below) THE SPOTTED DOLPHIN *sleeping. Slow beats of the tail enable him to maintain his position*

Photo by J. Carver Harris

quently with mouths wide open and occasionally snapping their jaws together. Often the males would attempt to butt the female, but neither ever attempted to bite her. One male, as mentioned above, would never permit the other to get out of sight and the two constantly pursued the female for a period of two weeks.

In March another adult female was captured and placed in the tank. The same courtship activity was displayed again. This time only one adult male was present.

The period of gestation for any Cetacean (pronounced *see-tay'-shean*) is not definitely known. Considerable interest is therefore attached to the fact that the porpoises here have mated. It is hoped that the near future will witness the birth of a porpoise.

From observations on the animal for a period of a year and a half, the observer cannot help feeling that the animal possesses a high degree of intelligence. It is hoped that the future will bring about the opportunity to test accurately the mental abilities of these captured Cetaceans.

The fact that these animals not only readily learned to take food, but also quickly lost their fear of the feeding attendant is a tribute to their adaptability. During the first month and a half of their captivity the adult and baby originally caught learned not only to take food from the hand of the attendant but also to raise their heads out of the water. By the end of the second month, both were jumping three-quarters of their lengths out of water to take food. Since that time several other porpoises have learned to do likewise.

During the second month of the original pair's cap-

Photo by [illegible] Masters

(Below) MALE PORPOISE, *at right, warns new arrivals at Marine Studios that he is boss by snapping jaws*

(Above) A PIGMY *sperm whale* (Kogia breviceps) *washed ashore near Marineland in a storm lived only a few hours*

Photo by Mrs. C. V. Whitney

tivity, they were also found to be curious about a human swimming underwater with them. In the short training period they learned to come over and take fish from such a person's hand. Within a short time after, they also learned to take food from the hand of a diver walking on the bottom in a shoulder helmet. The original young porpoise, in fact, frequently annoyed the diver when he was going about his daily window cleaning duties, by playfully nibbling at his feet.

This young one was also keen about playing with any human, whether a stranger or not, and would come to the surface and gently nibble a hand which was offered to her. The young one also delighted in being scratched on the belly, and would repeatedly come back and roll on her side at the surface for more.

Partially deflated rubber balls were kept in the tank solely for the amusement of the young porpoise. She would grab the ball in her mouth, pull it below water and release it. Her eyes intensely followed the ball as it rose to the surface and bounded out of water. Many other objects in the tank excited the curiosity of the young porpoise, including turtles of all sizes from 25 to 300 pounds. The young one was noted on several occasions to tip a 50 pound loggerhead turtle up, so that its body lay in a vertical plane, and push it completely across the tank at the end of her snout.

The baby's playfulness, however, was her undoing. In the early fall of 1938, two manatees were placed in the tank—an adult female and her young nursing offspring. The manatees tamed quickly, and soon learned to come to the surface to eat eel grass from the hand of the keeper. On these occasions the two porpoises, particularly the young ones, would butt the manatees persistently, until they retreated. The young one carried this jealous activity even further and would take eel grass from the mouth of the young manatee and streak across the tank shaking the grass throughout the water with a sidewise motion of her head.

THESE *two porpoises learned to eat from a plate but always took the food below water to swallow it. They swallow fish without chewing, head-first. The minute openings behind the eye are the rudiments of the ear opening. They are scarcely large enough to permit the entrance of a toothpick*

Photo by Wm. F. Gerecke

The porpoises do not take a running start in order to leap up for food. They start from the surface and drive themselves steadily upward by powerful sweeps of their tail. It is therefore possible for a porpoise to hold the position at right for several seconds. Should one lose balance while suspended in air, however, he almost invariably falls backward, thus avoiding the possibility of injury against the steps of the feeding platform

Photo by Nelligan Masters

In early December, the young porpoise's appetite began to fail. A castor oil treatment was finally resorted to. On the morning after Christmas, however, the lifeless body of the young one was found being supported at the surface by the bereaved parent, presumably so that if life yet remained in the porpoise it could breathe the necessary air. How long the parent had held the body at the surface was not known, but for several days following she showed unmistakable signs of grief. The young porpoise's stomach was found to be stuffed solid with undigested eel grass. Although the animal had never been observed to swallow the grass, it must have done so during the frequent thefts of the manatee's food.

A dinner bell is habitually rung underwater at the beginning of each feeding, but the porpoises have other means of knowing when the feeding time approaches, because they are always on hand in front of the feeding platform with heads raised out of water, at least ten minutes before the feeding is to begin. Because crowds always gather on the top deck before each feeding, their presence affords a cue to the animals; but on rainy days when the visitors do not stay on the top deck, the porpoises still gather in anticipation of the feeding.

At each feeding, a diver also goes in the water to feed the animals by hand, and, although animals such as large turtles, jewfishes and sting rays, actually bite the diver's body in their enthusiasm for food, the porpoises always remain poised and waiting for the food to be offered to them. They also wait their turn and practically never attempt to shoulder each other out of the way. This is not true, however, when fish is being thrown to them at the surface, because in those cases several swim for the fish and the fastest gets it.

Recently, a large manta ray with a wing spread of thirteen feet has been living in the oceanarium with the porpoises. This ray circled the edge of the tank constantly 24 hours a day. This greatly disturbed the sleeping porpoises because they were accustomed to sleeping in the same region in which the manta now swam. For the first two days the porpoises did not get much rest but soon proved their adaptability by restricting their sleeping to the center of the tank where the manta seldom intruded.

Fascinating visitors by their almost continual activity at all hours of the day, the porpoise school is an outstanding wildlife exhibit. The adaptability of the mammals as a laboratory subject has been proved, and investigations into their physiology have begun. By the provision of adequate laboratory facilities and the subsequent attraction of specialists in the fields of mammalian physiology and behavior, the earnest hope of Marine Studios is, that its unique facilities will offer the means of elucidating the life habits of these highly specialized mammals—the Cetacea.

MEAT-EATING PLANT

OF all the manifold ways in which Nature's creatures contrive to get food, the plant shown here uses one of the most extraordinary. It departs widely from the normal plant process of drawing nourishment from chemicals in the earth and air. Plants ordinarily are the passive victims of animal appetites unable to flee or fight back, and without them no animals could live on earth. Yet here is one, our Venus's-flytrap of North and South Carolina, which, though fully a plant, turns the tables on the animal kingdom and eats meat

1

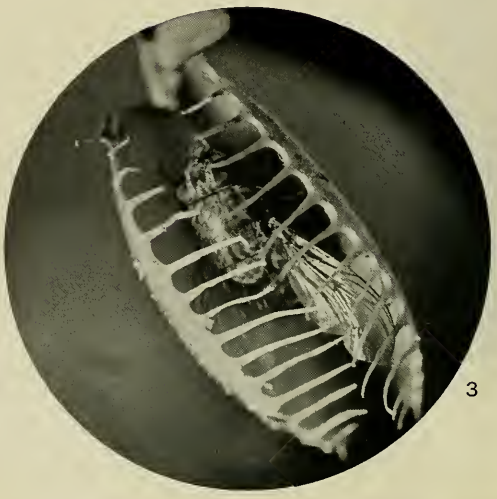
1 The Venus's-flytrap *(Dionaea muscipula)* lures an unsuspecting victim, a bluebottle fly, to its death. Attracted by the perfume of the plant's juices, the fly lights on a leaf, and by means of a sodastraw-like sucker, proceeds to drink

2 The irresistible potion gets stronger as the insect walks eagerly toward the center of the leaf. Unnoticed in the fly's haste are four hair triggers, which it carelessly brushes in passing. Always set for action, these triggers work only when a single hair is touched twice or more than two, once. Only living prey is apt to do this, and so premature closure of the leaf is prevented when bits of stone, twigs, etc., fall into the trap

3 In the thousandth part of a second, the halved leaf snaps shut over its helpless victim. The spikes on the leaf's edge form a veritable cage of death and prevent the fly's escape. The walls have enclosed the insect in a relentless grip, with a tenacity and strength that is one of the wonders of the botanical world

Graphic Features Photos
By KEINIGSBERG

2



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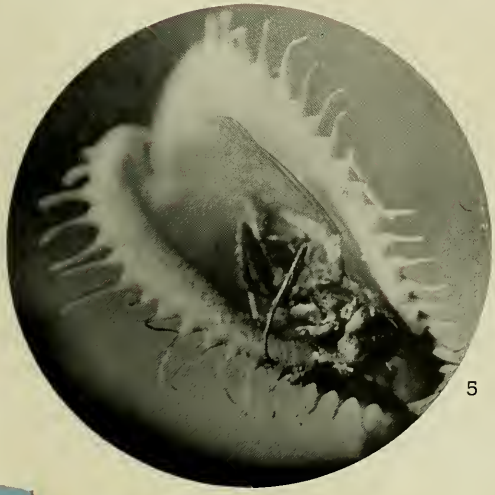


5

4 The plant closes tighter until the fly, partly crushed and perhaps drugged by the intoxicating secretions, ceases its struggles, while the plant settles down to enjoy its meal. The plant trap does not close all the way, and tiny openings are left between the bars to enable ants and other small insects to escape. Only the more useful insects are thus captured, for once the plant starts feeding, it does not open for days and a tiny insect is not sufficient nourishment

5 Four days later the leaf trap opens, having absorbed the edible parts of the insect by means of digestive fluids, and ejects the fly. The principal food it has obtained is nitrogen, scarce in its native habitat—a small area in the swamps of eastern Carolina, the only place in the world where the plant is found. The plant is once again open and ready for its next victim

MAN OR APE?

The remains of Java Man, probably 300,000 years old, rank as one of the most important links in human evolution. Newly discovered fragments, which add to our knowledge of Man's beginning, are shown reconstructed here for the first time

By FRANZ WEIDENREICH
Honorary Director of the Cenozoic Research Laboratory
Peiping Union Medical College, Peking, China.
Visiting scientist, American Museum

(Below) THE LATEST SUMMARY *of Man's distant past as revealed through the bones of Java Man and the restoration of his skull by Dr. Franz Weidenreich.*

Ever since the first bones of Java Man were discovered in 1891, the most serious scientific and popular interest has surrounded this ancient human ancestor. Skull IV, discovered last year by Dr. R. von Koenigswald, bears out earlier deductions and allows further conclusions. A wide cleft in the skull reveals that this individual may have been killed by a stone or even a weapon. This hints that Java Man may have been a tool-using creature, endowed with greater aptitude than any existing ape. Note, however, the low forehead and heavy eyebrow ridges

IN August, 1891, Dr. Eugène Dubois, then a Dutch health-officer, found near Trinil in central Java, in the left bank of the Solo River, "among a great number of remains of other vertebrates, the bones and teeth of a great man-like mammal." With these words one of the most important discoveries of human history was announced. "I have named it *Pithecanthropus erectus,* considering it as a link connecting apes and man," the discoverer continues, assigning thereby this newly found type to a place within the supposed line of human evolution.

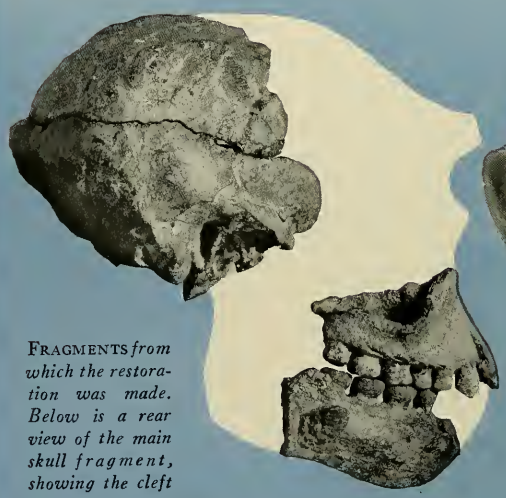
As to the time in which Pithecanthropus lived, Dubois concluded that it belonged to the latest epoch of the Tertiary period. This would put the age at perhaps one million years. According to the latest geological interpretation, however, Dubois took too long a span, for Pithecanthropus is now believed to have

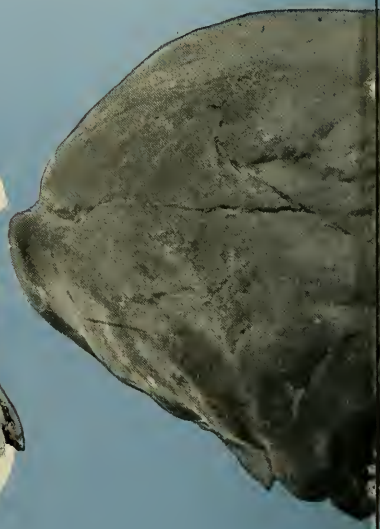
GORILLA
(Modern)

IN SKULL CAPACITY *the gorilla (above) with 600 c.c., stands as far below the Java Man (900 c.c.) as Modern Man is above him, with upward of 1250 c.c.*

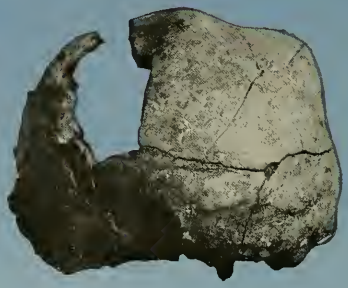
The age of Java Man, estimated at 300,000 to 400,000 years by the author, is based on the evidence of the geological strata and accompanying fauna. A more accurate reckoning will be possible when the land between Java and Northern India, where the Glacial Period is recorded, is explored

PITHECANTH





FRAGMENTS *from which the restoration was made. Below is a rear view of the main skull fragment, showing the cleft*

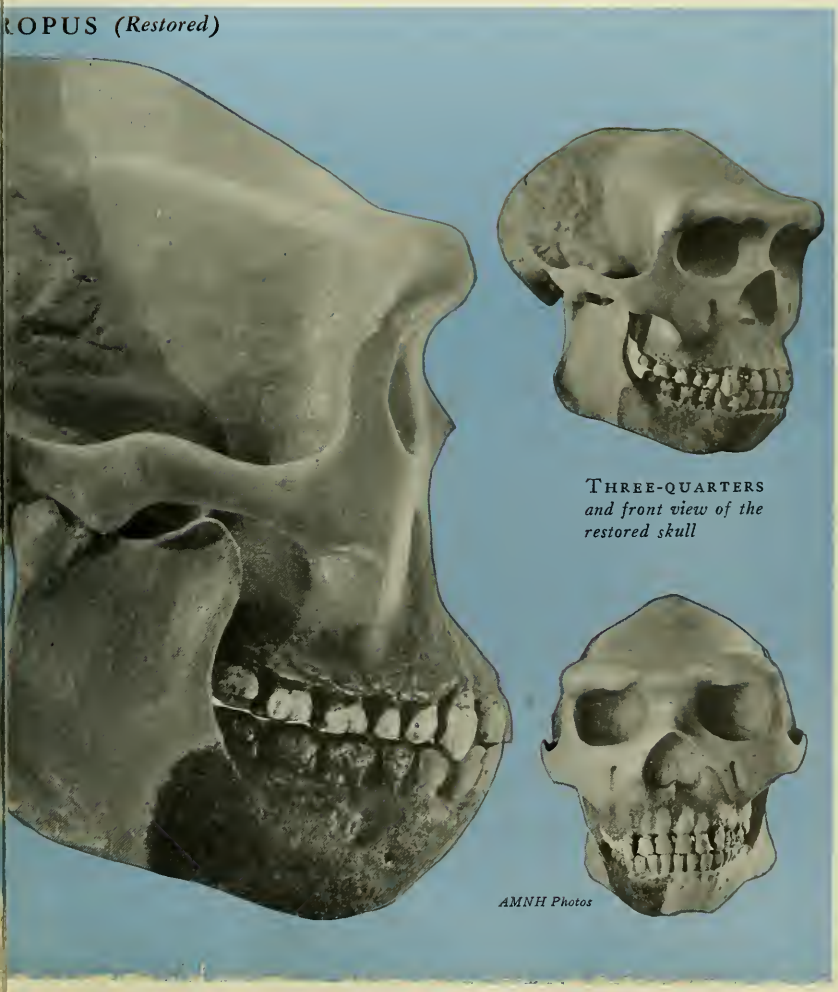


lived in the Middle Pleistocene period, which might be 300,000 or 400,000 years ago; and there are those who say that even this may be too old.

The bones Dubois refers to consisted of a skullcap and a thighbone, both of them remarkable for their special appearance. The skullcap, quite different from the modern type, is small, low and extremely flat, and provided with heavy, protruding eyebrows. The thighbone, long and strong, and resembling in all parts that of recent man, shows a strange abnormality consisting of a large and irregular bony outgrowth on the inside of the upper half. Such a pathological structure occasionally occurs in exactly the same place in recent man as a consequence of a peculiar form of chronic inflammation of the muscles called ossifying myositis.

The obvious disharmony between the ape-like skullcap and the human-like thighbone at once aroused serious doubt that the two really belonged to the same individual, as Dubois assumed, or even to the same type. Yet the liveliest discussion concentrated on the identification of the skullcap. Nothing demonstrates more the great contrast of opinions in this regard than the judgment of the English anatomist Cunningham, and that of the German anthropologist Rudolf Virchow, delivered in the same year, 1895. According to Cunningham "the fossil cranium described by Dubois is unquestionably to be regarded as human. It is the lowest human cranium which has yet been described. It represents many Neanderthaloid characters but stands very nearly as much below the Neanderthal skull as the latter does below the ordinary European skull." Rudolf Virchow, however, stated that the skullcap did not belong to a man but showed, on the contrary, the greatest resemblance to the skull of Hylobates, the gibbon. He took the position, therefore, that in accordance with all the rules of classification, this individual, *Pithecanthropus erectus,* was an animal—in short, an ape.

In a later and more detailed paper (1924) Dubois himself defined his final standpoint as follows: "The form of the skull is on the whole not human, nor does it represent a transition between any of the man-like apes and the human type." Dubois believes that both Man and Pithecanthropus descend from a common primitive simian ancestor which resembled the gibbon closer than the actual great apes as represented by gorilla, chimpanzee and orang. In one of his latest publications Dubois actually called Pithecanthropus a giant gibbon but added the reservation that this



RECENT MAN
(Northern China)

THOUGH *in many ways a link between Modern Man and the ape,* Pithecanthropus erectus *shows more human traits than simian, and further exploration may reveal that he was a skillful hunter acquainted with the use of fire like his cousin, Peking Man. Whether he had a language, a religion, or family organization, science cannot yet say*

designation should indicate only the special line of evolution, and insisted beyond that on his first interpretation of Pithecanthropus as an advanced ape intermediate between man and gibbon.

Most students, however, came to the conclusion that the type of the skullcap, disregarding the question of its exact position in the line of evolution, looks more like man than ape. Professor J. H. McGregor of Columbia University, for instance, was so convinced of the correctness of this conception that he ventured 20 years ago, to restore not only the entire skull but also the head, giving to both the general traits of man.

Peking Man

But the problem itself remained unchanged as long as the skullcap of Trinil continued to be the only known representative of such an early type. In 1929, however, a very similar but more complete skull was discovered, not in Java but rather far away in Northern China, and representing a type which lived contemporaneously with Pithecanthropus. As Davidson Black, who gave the first description of this find, saw at the first glance, the general character of this skull was exactly the same as that of the Trinil skull, in spite of the differences in some details. Since Peking Man or *Sinanthropus pekinensis,* as this newcomer to human ancestry was named, proved undoubtedly human, there was no escape from the conclusion that Pithecanthropus, too, should be construed as man and not as ape. The human nature of the Peking Man, moreover, has been confirmed by a series of subsequent finds of skeletal remains from the same site. Altogether about 40 individuals, including males and females, adult and juveniles, have been unearthed up to present.[1]

In the meantime Java Man himself has played an essential role in unraveling the riddle which still veiled his actual character. Here we owe the unexpectedly abundant increase of our knowledge to the farsightedness, the perseverance and energy of Dr. R. von Koenigswald in Bandong in Java. Thanks to the subsidy of the Carnegie Institution of Washington, he was able to set up a very effective organization to search systematically all the localities which had yielded fossil material of the same nature as that which once came to light in Trinil.[2] An area west of Trinil proved particularly productive. This region, formerly a vast dome, has collapsed in its central portion, thereby exposing typical Trinil formations around the inner slopes of the whole circumference.

From this so-called Sangiran district there came in 1936 the fragment of a lower jaw with four teeth still in place[3] and, from another site, a brain case with some of the basal parts preserved.[4] According to the size and the robustness of bone and teeth, the jaw must have been that of a male individual. As regards the brain case, it resembled Dubois' original skullcap as one egg does another, differing only a little from the latter in size and shape. It is distinctly smaller but relatively broader and not quite so flat. Since this second skull was more complete than Dubois' Skull I, retaining in particular the temporal bones along with the ear region on both sides, Doctor von Koenigswald has been able to demonstrate beyond all possible objections that Java Man is not an ape but a man.

Still further evidence came to light in 1938 with the discovery of a skull fragment from the same Sangiran district.[5] This piece apparently belonged to a juvenile skull but nevertheless possessed some of the characteristics of Skulls I and II. At the same time it substantiated the close relationship of Pithecanthropus to Peking Man, since the top of the skull exhibits the same strong longitudinal crest.

The latest and most important find of Pithecanthropus was made in January, 1939.[6] The circumstances of this discovery are so exciting and moreover suggest so strongly the possibility of further success in exploring this area that I think it justifiable to tell its story.

Doctor von Koenigswald had decided to go to Peking to study with me the Pithecanthropus material at the Cenozoic Research Laboratory, the best equipped place nearest to him. Some days before he left Java, one of the collectors sent him a jaw which, in spite of being covered with a thick coat of matrix, was recognized immediately by von Koenigswald as an upper jaw of a great ape or Java Man. Since the breakage was fresh, he instructed the collector to return at once to the site where the jaw was found and look for the pertaining skull. The collector did this, recovered the skull, and sent it to Peking.

Evidence of violence

After preparation it turned out that the skull consisted of the posterior three-quarters of the brain case including the base, while the entire frontal region and the face were missing except for the upper jaw referred to above. The skull shows a wide cleft which passes through both cap and base in an oblique direction from in front and right to behind and left. The direction of the cleft, the straight lines of breakage and the smoothness of the margins of the split bones raise the suspicion that the crack may have been brought about by either a stone accidentally shaped like an ax or even possibly by an implement.

In addition the entire skull was crushed. Probably after the splitting had occurred, the skull was submitted to some kind of strong pressure working in

transverse as well as longitudinal direction, with the result that the bones of the skull, having already lost their continuity by the cleavage, were dislocated and partly telescoped. That this even took place immediately after death can be inferred from the fact that all the dislocated fragments sticking together have been consolidated in their new position by fossilization. The upper jaw has suffered to a certain extent the same destiny, proving that the jaw actually belonged to the skull and had been separated from it subsequently. In spite of the crushing to which the skull has been subjected, both the general character and the individual details can be clearly discerned. The original size and shape, however, were difficult to ascertain in the present state.

I made the attempt, therefore, not only to restore the dislocated bones but also to reconstruct the entire skull by completing the missing parts of the frontal region, face and lower jaw. The restoration was made on the basis of casts and executed at the Palaeontological Laboratory of the American Museum of Natural History. To Drs. Barnum Brown and Walter Granger I am deeply indebted for their kindness in making their resources available for this task. I feel in particular obliged to Mr. Otto Falkenbach, to whose understanding and technical skill the achievement of the work is to be credited. For the configuration of the frontal region, Pithecanthropus Skulls I and II have served as models and for the superior part of the face the corresponding Sinanthropus material. The lower jaw was restored on the basis of the Pithecanthropus fragment found in 1937 and completed by adapting it to the form and size of the upper jaw, supplementing for the missing parts data taken from Sinanthropus jaws.

As the restoration reveals, Pithecanthropus Skull IV represents undoubtedly a male individual. It is considerably larger than the other two skulls, and all the details of the muscular relief are correspondingly much more pronounced than they are in the latter. The most striking peculiarities of the brain case are its lowness, the flatness of the forehead, the heavy and protruding eyebrows, and the huge longitudinal crest extending over the top of the skull. In addition, the skull is very broad in proportion to its length and possesses a peculiar rounded back.

Enormous upper jaw

The upper jaw is not only enormous as a whole but also extraordinarily wide, exceeding in this regard all human and simian jaws known hitherto. In accordance therewith, it projects farther beyond the face than in any other case of fossil man. One of the most conspicuous particularities, however, concerns the teeth. They are as a whole large and robust, corresponding to the size of the jaw. Yet, the canines are relatively small, and though they surpass in height the neighboring teeth to a greater extent than has ever been observed in man, with the exception of Sinanthropus, they do not show the characteristics of simian canines either in size or in form. Even more surprising is the fact that they are separated from the incisors by a wide gap, which is specific for all the apes but has never been found in any human skull. The enormous size and robustness peculiar to the original fragment of the lower jaw and the reconstructed jaw repeat the massiveness of the upper jaw. No chin is present, and the molars are large, increasing in size from the first to the third unlike the usual sequence in man. The canine socket of the lower jaw is small, giving, therefore, good reason to believe that the lower canine was as small as the upper one. Moreover, no gap between the canine and the first premolar existed.

Skull capacity

When Pithecanthropus Skull IV is compared with Dubois' Skull I and von Koenigswald's Skull II, it is immediately evident that the former represents a male and the latter females. But in spite of the greater size of Skull IV, it cannot have had greater brain capacity than Skull I, considering the amazing thickness of the bones. It is to be noted that in size the Pithecanthropus brain stands about midway between the largest ape and the average modern man. I computed the capacity of Skull IV to be not much more than 900 cc., corresponding nearly to that of Skull I, while Skull II with a volume of 830 cc. is clearly smaller. The maximum capacity ever observed in the great apes (gorilla) amounts to little more than 600 cc., while the average in recent man totals about 1250 cc. for female individuals.

Apart from the conformity in the capacity of the brain case, the three Pithecanthropus skulls have some specific features in common, for instance: the lowness and flatness of the brain case, the remarkable restriction of the anterior temporal region, the breadth and roundness of the back, etc. The pronounced crest on the top in Skull IV has to be regarded as a sex character because of its slight and restricted development in Skulls I and II.

There is no doubt that Pithecanthropus Skull IV represents the most primitive type of fossil man ever found. This primitiveness, however, is not so pronounced in the Skulls I and II. On the other hand, as mentioned above, Java Man is closely related to Peking Man. In some details the former is more primitive, in others the latter. But when both are compared with the remaining specimens of fossil man found throughout the world, they stand out as a

special group distinctly lower in the evolutionary scale than all others which have come to our knowledge. The differences between the two types themselves are obviously equivalent to the regional differentiations such as are expressed in the various races of today. Within the special phase of evolution to which Java Man and Peking Man have to be assigned, the former represents a crude type, the latter a refined one, just as among modern man the Australian native and the Chinese express primitive and advanced types of the same stage.

Dubois gave his Pithecanthropus the surname "erectus" because he deducted from the appearance of the thighbone, attributed by him to this type, that Pithecanthropus already had adopted an upright posture. Dubois tried later to confirm this view on the basis of five more thighbones of the same character discovered subsequently among old Trinil material stored at the Museum in Leiden. Unfortunately, no more limb bones were found in connection with the new skulls. The conclusion, therefore, that Pithecanthropus possessed erect posture still remains in doubt. But as regards Sinanthropus, fragments of seven thighbones and one armbone are now available, which prove that Peking Man was certainly an erect type. This view is supported by the nature of his cultural relics, which demonstrate that he was an effective hunter and already knew the use of fire. The limb bones of Sinanthropus reveal, therefore, the very remarkable fact that the body already had reached an advanced stage of evolution, while the skull, including the teeth, lagged behind. The close relationship between Peking Man and Java Man suggests that they cannot have differed essentially with regard to their posture; in this connection one peculiarity of the Pithecanthropus Skull IV is of greatest importance. The situation of the joint which holds together skull and spine, as well as the configuration of the surrounding parts of the base of the skull, resembles much more the condition in recent man than is the case in Sinanthropus. This seems to indicate that if Sinanthropus had already acquired an upright position—a fact which scarcely can be doubted—Pithecanthropus certainly did so. Do the debated thighbones after all belong to Pithecanthropus? The future may decide.

The answer to the question I put at the head of this article is that Java Man *was* a man. That means that he was not a giant gibbon nor a creature similar to this. Nevertheless, Java Man was not at all identical with recent man. His skull and his teeth exhibit a number of characteristic traits strange to man of today but familiar to us when we remember the gorilla or chimpanzee. This is exactly what we have in mind when we consider man as a branch of a simian stock or what Dubois meant when he designated Pithecanthropus as "a link connecting apes and man." McGregor gave to his reconstruction of the Java Man, based only on the fragmentary skullcap of Trinil,

(Below) THE FAMOUS FIRST SKULLCAP *of* Pithecanthropus erectus, *found by Dr. Eugène Dubois in 1891. Beneath it is shown Professor J. H. McGregor's reconstruction of the entire skull based on this earliest material. The face he gave Java Man after careful study looks much more like a man's than an ape's. This and other deductions were borne out by later discoveries*

the aspect of an intermediate form decisively closer to recent man than to any of the existing apes.

There is often some skepticism among laymen when the scientist, with fragmentary relics, deduces the shape of missing parts. But trust in the fundamental soundness of the methods is given when further discoveries bear out early deductions. Such a case is Doctor McGregor's reconstruction. How right he was is shown by the subsequently discovered material on which the restoration of Skull IV is based.

(Below) PITHECANTHROPUS SKULL II, *discovered by Dr. R. von Koenigswald not many miles from the first material in central Java in 1937. In form it is almost identical with the first skull but more complete*

MAN OR APE?

The true nature of the relationship between man and the great apes is best illustrated by assuming that there once existed a common ape-like stem which early became divided into two main branches, one evolving in the direction of man, the other in that of the great apes. Both developed their own peculiarities: the human branch above all displayed the tendency of the brain and correspondingly the brain case to expand at the expense of the chewing apparatus but retained, on the other hand, certain primitive features which were lost during the process of differentiations in the simian branch.

When and where the division of the main stem took place, no one can tell. But so far as Pithecanthropus and Sinanthropus are concerned, their common ancestor must be buried somewhere in South Asia. Java is a very young island which emerged from the sea in late Tertiary, so it must have been peopled by an early man who came from India. That is, therefore, the place where we have to furrow if we are anxious to unveil the secret concealing man's earliest history. For the moment the most urgent task is to continue the work in Java which has now come to a standstill because of the exhaustion of available funds. There should be established a foundation taking care of all research work on early man in all parts of the world, dealing not only with his physical appearance but also with his cultural life and his entire environment.

In comparison with the vast work that remains undone, the study of man's beginning is yet in its early stages. The romance of these discoveries commands the interest of every thinking person, and science has proved how productive the search can be. The new knowledge which everyone will eagerly await, will be limited now only by the facilities for research.

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[1] For further information concerning Sinanthropus, see "The Face of Peking Woman," by Franz Weidenreich, NATURAL HISTORY Magazine, May, 1938, and "Our Most Ape-Like Ancestor," by Teilhard de Chardin, NATURAL HISTORY Magazine, September, 1937.

[2] G. H. R. von Koenigswald, "Anthropological and Historical Studies Relating to the Earliest Evidence of Man." *Year Book* of the Carnegie Institution (Washington, 1939), pp. 319-324.

[3] G. H. R. von Koenigswald, "Ein Unterkieferfragment des Pithecanthropus aus den Trinilschichten Mitteljavas." *Proc. Kon. Akad. Wetensch* (Amsterdam, 1937), XL, pp. 883-893.

[4] G. H. R. von Koenigswald, "Ein neuer Pithecanthropusschädel, *Proc. Kon. Akad. Wetensch* (Amsterdam, 1938), XLI, pp. 185-192.

[5] G. H. R. von Koenigswald and Franz Weidenreich, "Discovery of an Additional Pithecanthropus Skull," *Nature* (London, 1938), CXLII, p. 715.

[6] G. H. R. von Koenigswald and Franz Weidenreich, "The Relationship between Pithecanthropus and Sinanthropus," *Nature* (London, 1939), CXLIV, pp. 926-929.

THE ESKIMO GOES MODERN

Yesterday's Stone Age savages are today's most comical and pathetic civilized men

By PHILIP H. GODSELL

To anyone sharing the popular misconception that the Eskimo is "dumb" I would recommend a jaunt to Aklavik, diminutive metropolis of the arctic at the mouth of the Mackenzie in Canada's Northwest Territories.

Despite the fact that I have been associated with the Indians and Eskimos for nearly 30 years I received a surprise myself when, not long ago, I stepped ashore there from the stern-wheeled *Distributor*.

Strolling along the mosquito-infested waterfront I beheld some 60 trim, two-masted motor schooners, the quarter of a million dollar fleet belonging to the Eskimos who had just sailed over from Whitefish Station to meet the river steamer and report that six of their number had succumbed to a diet of rotten whale meat.

"Ukulele Lady" in the arctic

Aklavik sounded more like a midway than a silent settlement near the shore of the Polar Sea. From the hatchway of every schooner boomed out a strange medley of gramophone music. "Rock of Ages" fought hard to compete with the cracked strains of "Ukulele Lady," while "Dardanella" mingled strangely with "Cohen on the Telephone" and "How Are You Gonna Keep 'Em Down On the Farm."

But what really caused my eyes to widen was the sight of one of these Eskimos squatted on an upturned milk box pounding the keys of a Corona typewriter set on the hatch before him. With an appreciable sense of what Hollywood calls "atmosphere" he sported a navy blue suit and a pair of smoked glasses perched at a rakish angle on his nose.

"What's the idea?" I asked Charlie Christie, the factor.

"Watch," he smiled, "but don't let on."

His letter completed, the Eskimo slipped it in an envelope and handed it to a skin-clad youngster who padded down the gangplank and disappeared into the willows. A moment later there came from a sealskin *tupek* the tap, tap, tap of another typewriter. Then the lad skipped back to the schooner and handed his father the answer to his letter.

Mystified, I turned to Charlie. "Do these fellows actually write English?" I inquired.

His burst of laughter echoed along the shore. "Not a bit of it," he chuckled. "Those 'letters' are just a jumble of meaningless letters, figures and punctuation marks. Don't mean a thing. You see," he added, "both these fellows are chiefs, and carry on trading in the winter. They don't know a word of English. They're simply aping the ways of us traders to impress the other Huskies."

"But the typewriter?" I hazarded.

"Ilivernik on the schooner there saw me making notes with a typewriter while I was on an inspection trip last winter," explained Charlie, "and asked me to get one for him. Iksik, his trade rival over in the willows, heard about it and insisted I get him one, too. They just came in on the steamer, and those chaps are putting on this stunt to show the others how up-to-date they really are."

At Herschel Island, one-time rendezvous for the American whaling fleet, I received a still more amusing insight into the minds of these people.

From ivory carver to dentist

The year before, Doctor Millar, a traveling dentist, had erected his portable foot-drill at the post and got to work on the trappers and Mounties who needed dental attention. From the start his every move was watched by a fur-clad Eskimo named Mike. At the Eskimo's offer to help, Millar gave him some small job, finding, to his surprise, that Mike—a skilled ivory carver—was amazingly proficient. In a week he was proudly installed as dental mechanic, complete with white apron over his skin clothing.

When the time came for Doctor Millar to depart, Mike watched with downcast eyes as he dismantled the little foot-drill. Suddenly they lighted. "How much for you sell'um?" he asked.

"Five hundred dollars," laughed the dentist.

"Me take'um," came the prompt answer, and Mike

disappeared to return in a few minutes with a draft on his savings for the amount and a demand for "dat yeller stuff for fixum teet'!"

Next day, to the undisguised amusement of the whites, Mike departed to act as interpreter at the isolated outpost of Kent Peninsula among the primitive "blond" Eskimos, taking his dental outfit along.

Reaching Herschel Island I found to my astonishment that Mike, who had just returned, had a credit of over $6,000 for his year's work, despite the fact that his salary was only $600 per annum.

His explanation was short and to the point. "Me pix'im teet'," he grinned.

Then I learned that he had set up his foot-drill at the lonely outpost among his Stone Age cousins and got right down to business. Buttonholing the head *angatkuk,* or medicine man, he whispered that all "big chiefs" of the white *kablunats* had their eyeteeth covered with gold as a mark of distinction. He'd fix him up for four white foxes—two white foxes a tooth—the equivalent, at the time, of $240 at outside prices!

When, that night, the *angatkuk* displayed his gleaming molars, his people commenced to sit up and take notice. Next morning there was a line-up at Mike's hyperborean dental parlor. For two weeks Mike worked overtime, providing the Stone Age Eskimos with golden eyeteeth at two white foxes each. When his supply of gold ran out, he turned to the dental charts that Millar had handed him with a laugh. These, Mike explained, were good for stomach-ache, headache, birth pains or whatever ailed you, provided he made certain cabalistic signs on them with a big blue pencil. Then all you had to do was to stick the card in a buckskin bag and tie it against the afflicted part. The fee: merely one white fox, worth $60.

Homemade tooth

Incidentally, this isn't the first case of aboriginal dentistry in the arctic. Years ago a Mackenzie Delta Eskimo who had had a tooth knocked out by a harpoon handle saw a white man with false teeth. For a while he pondered the matter then, carving a tooth from ivory, root and all, he drove it into his jawbone with a mallet. And there the tooth still remained when I saw him 18 years later, and he was apparently none the worse for this painful but apparently effective bit of dentistry.

At the post the Huskies were busy trading off their winter catch of white fox pelts before pulling out for their winter hunting grounds on Banks Island and along the arctic coast. Every worthwhile Eskimo owned a motor schooner worth from $4,000 to $6,000. In fact it was no unusual thing for an Eskimo to drop in on Herbert Hall, the giant district manager and casually order a $5,000 schooner to be shipped in from Vancouver by the annual supply ship the following summer. He would deposit a few white foxes on account, make another deposit when the schooner arrived, load up grub and gasoline and sail away with his family. If he was lucky and ran into a big bunch of white foxes, he would pay off most of the debt the following summer. If he struck tough luck, he would pay what he could each year until he'd squared up. If he died, his relatives would club together and settle his bill. And when it came to adjusting a refractory motor, these Eskimos were little less than marvelous. With the utmost speed and despatch they would take the engine entirely apart, tinker around with screwdrivers, wrenches and bits of copper wire, put the thing together and continue on their way.

Even as I watched, a white trapper's schooner stalled in mid-stream. As his flow of profanity came drifting across the waters, a grinning Eskimo hove alongside, climbed aboard and proffered both help and professional advice. An hour later the engine uttered an asthmatic cough. The Huskie wiped his sweating forehead with the sleeve of his cotton "dickie," clambered aboard his own craft and waved a friendly adieu as the white man chugged off downstream.

Meanwhile a raucous burst of laughter drew me to the store in time to see a portly Eskimo lady of some 60-odd summers exchange a white fox for a pair of scarlet silk bloomers. Pulling them nonchalantly over her skin pants, she proceeded to strut and cavort about the floor, her skirts upraised so that all the male members of the tribe could admire the scarlet glory of her new finery. The last I saw of her she was displaying the bloomers to the red-faced bishop and his wife outside.

Sunday finery

Sergeant Clay of the Mounties emitted a malevolent chuckle. "Reminds me of the time I had charge of Sinissiak and Uluksuk, the Huskies who killed the priests," he grinned. "I'd taken them over to Fort McPherson to meet the steamer. The weather was hot, and I was getting rid of some surplus baggage when I came across two suits of heavy woolen combinations. One I gave to Sinissiak and the other to Uluksuk, and promptly forgot them. Sunday came along. The church bell was ringing and all the Loucheux bucks and squaws were parading to the Mission in their best store clothes with a 'holier-than-thou' expression on their faces. Suddenly the Inspector bounced out of his chair. 'Quick, Sargeant,' he snapped, 'get out there and grab those two Hus-

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(Above) A LAND *of sun-baked deserts and arroyos, America's Southwest guards perhaps more of our continent's secret past than any other region. The Spanish Conquest lingers in its place names; and its Indians worship gods old before Columbus.*

It was in the direction of this shimmering horizon that the author, a doctor on vacation, entered upon a scientific adventure. The prehistoric tracks were found on the mesa in the distance

PLACE OF

The guide remembered strange animal tracks in the red sandstone and knew a sacred cave whence the Word of ancient gods cast its spell on the twentieth century Navaho

(Left) IN THIS STEEP SLOPE, *Doctor Gardner found the supposed "buffalo tracks" which his guide had remembered seeing years before. The tracks were in a sandstone layer 100 feet below the top of the mesa, indicating their antiquity*

(Right) CLOSE-UP *of the cloven-hoofed tracks. The author selected several slabs for shipment to the American Museum of Natural History in New York. Could buffalo have once been plentiful in this arid wasteland?*

Drawing by John C. Germann

THE GODS

By
WILLIAM A. GARDNER

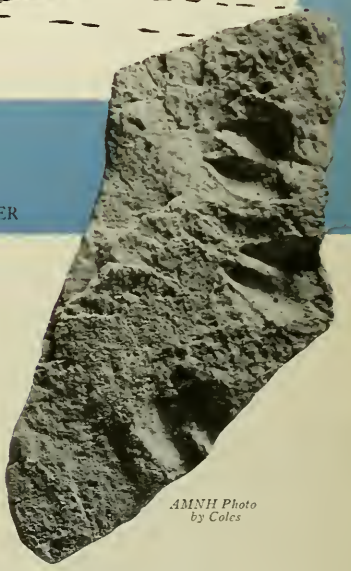
I STEPPED out of the air-conditioned comfort of the Santa Fé Pullman into the hot silence of the desert. En route from New York to the San Francisco Fair, I had decided on a quick stopover to visit the Canyon de Chelly.

At Gallup I engaged Sam Day to drive me to the Canyon. Jack Hubbell, whose father, Roman Hubbell, provided the car, was to go along as an auxiliary scout.

Sam was a hardy veteran of the Southwest who had been road builder, forest ranger, locomotive engineer, Indian trader, and free-lance explorer. Speaking Navaho before English, he had grown up with the Indians and had married a Navaho woman. An enthusiastic singer and dancer, he had—after this marriage—been officially adopted by the tribe, and had been permitted to join in all its ceremonies on equality with the Indians.

As we drove north to the Canyon, Sam entertained me with stories of train wrecks and forest fires, and—above all—of Navaho customs and religion. His detailed knowledge of the country amazed me. On the barren top of a mesa he took me a mile from the road and showed me, hidden beneath a jutting ledge, a shrine, known to no other white man, enthroning the male and female stone images of the god-goddess of the South. He told me of the four-day funeral services in which he took part when his Navaho wife died. Near Fluted Rock we met a medicine man friend, and spent an hour in palaver on the floor of a hogan, or earth-covered lodge.

AT THE MUSEUM, *Dr. G. G. Simpson pronounced the tracks to be those of an extinct American camel which, probably at least 100,000 years ago, roamed America's deserts, as the artist has depicted above*



AMNH Photo by Coles

I began to feel the lure of the desert and its primitive inhabitants. Presently Sam told of stranger things—"buffalo tracks" in stone, and a sacred cave in the Lukachukai Mountains. It was then I decided that credulity would teach me more than cynicism, and I abandoned the San Francisco Fair in favor of Adventure.

From Chin Lee and the Canyon de Chelly we turned southwest into the valley of the Pueblo Colorado River. Here was an immense wasteland, bordered on the east by a line of high mesas. Here, many years ago, Sam had superintended the building of a dam designed to catch the rare flood waters. From the distant mesas, Indians had hauled rock for the dam. One day Sam noted some peculiar impressions on a slab of sandstone, which looked like tracks—like

(Below) VALLEY OF THE GODS: *Do-Yah-Kay-Ah—"the wonderful, the mysterious, the mystic place"—which had theretofore never been visited by white men. Tucked away in this little-known corner of Arizona lies the secret Mecca of the Navaho religion. Here, legend runs, the messengers of the Sun God ended their circuit of the mountain-bordered Navaho world and left his teachings in a sacred cave before returning "Beyond." Thither journeyed Doctor Gardner with his guide Sam Day, whose Navaho wife had given him entrée into the religious mysteries of the tribe*

buffalo tracks. The Indians, however, had neglected his order to save the slab, and it had been lost in the dam.

With this memory as our only clue, we headed first for the dam site, some 20 miles south of the tiny Navaho settlement of Kleg-E-Toh. From the dam we drove east across the dry wash to the line of mesas. Here we spent several weary hours under the glaring Arizona sun, looking for the hypothetical tracks. The mesas rose from one to two hundred feet above the wash, in horizontal layers of limestone and red sandstone, their sides strewn with the debris of erosion.

Suddenly Sam shouted from the top of one of the lower mesas. I ran over to find him pointing at the tracks. Here they were by the score, in a six-inch layer of fine-grained red sandstone, which formed the top of this mesa. The tracks varied from two to four inches in diameter, and from one-half to one inch in depth, and showed with perfect clearness the imprint of a cloven-hoofed animal. Strange feelings came over me: of Time, and life long ago, of the persistence of identity through change. The same sun shone over-

(Left) THE SACRED CAVE *was guarded only by an aged woman, who allowed them to pass on being assured that they had come to scatter sacred pollen at the shrine of the Sun God. The shrine is located in the cave at the right*

(Right) APPROACHING CLOSER, *Doctor Gardner found the cave to be in the shape of a huge band-shell. The foot-worn entrance gave mute evidence of the generations of medicine men who had come to learn the message of the Sun God. The function of the medicine man resembles that of the minister in the white man's religions. He must interpret the Sacred Word, which for lack of a bible, is found in legends, dreams, and graphic symbols such as decorate this cave*

(Above) THE MESSAGE OF THE HANDS *is obscure to the white man but to the medicine man it is full of supernatural meaning. These brightly colored hand imprints are among the ancient symbols on the cave walls*

(Above) LIKE OUR HOLY TRINITY *the Navaho Sun God is a multiple person having four manifestations represented by these clay masks. Keeping his promise to the old woman, the author did not disturb them to see what lay underneath*

(Below) ANOTHER VIEW *of the ancient cave. Nearby pottery shards were found to date from "Pueblo III" (about 1000-1100 A.D.). This indicated that the handprints and other symbols were made by the pre-Navaho Pueblos, whose relics their successors made into fetishes*

Photos by William A. Gardner

head, but through what vastnesses of Time, from the day when a living creature stepped into soft mud to make this mark!

We brushed off the whole top of this mesa with piñon branches, uncovering several hundred tracks. By horizontal sighting we picked up the same track layer in nearby mesas. In the high ones this layer was at least one hundred feet below the present summit. Broken slabs of the track layer lay below the intact stratum. We collected some of these as trophies. One slab bore two hoof tracks, and a third, larger, clawed track which Sam said looked like a bear's.

Subsequently, some of these slabs were sent to New York where I turned them over to Dr. G. G. Simpson of the American Museum of Natural History. After careful study, Doctor Simpson tells me that the tracks were not made by buffalo, but by camels. He believes that they were made by the extinct genus of camel, *Tanupolama,* a small-sized variant, formerly abundant in the American Southwest. The "bear track" Doctor Simpson cannot positively identify, but believes it to be either that of a bear or a giant sloth. He dates the fossils as belonging to the Pleistocene Age, and as possibly being a hundred thousand years old. Similiar tracks were discovered

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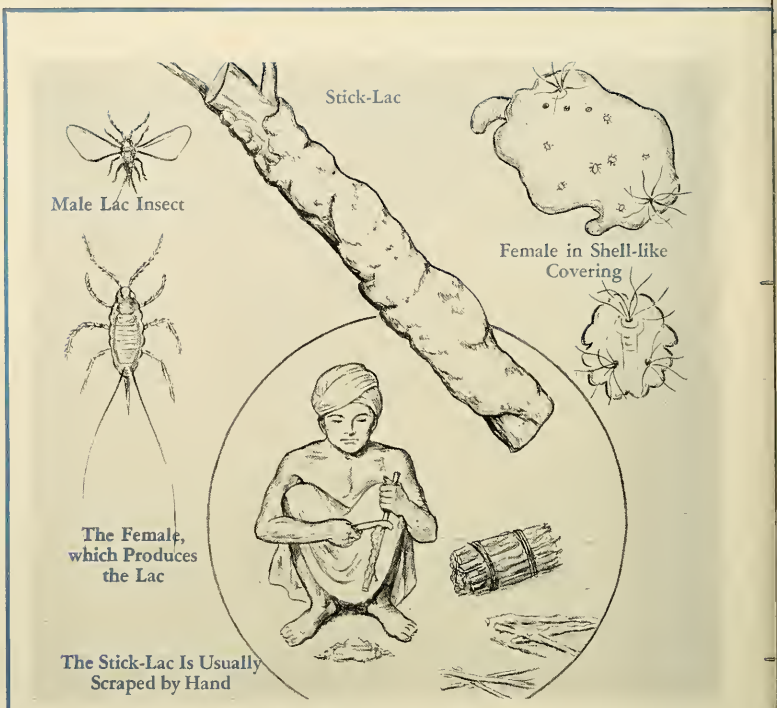
INSECT

Commonly overlooked as manifold benefactors of man, insects, among many other services, manufacture a number of products which make the world a distinctly better place to live in. The inside stories of some of the more important ones are told here.

SHELLAC and the beautiful Chinese lacquer work both have their beginnings on the twig of a tree. Colonies containing countless numbers of lac insects are necessary to produce a small stick, which would explain the derivation of the word from the Sanskrit *laksa,* meaning "hundred thousand."

Where lac is under cultivation, the insect's favorite trees are pruned to produce many succulent shoots. In its beginning the colony contains winged and wingless males and a larger supply of females. As it grows it is said to become a harem of some 5000 females to each male. The females are much bigger than their mates. The insects fasten themselves to the bark of the twig, extracting juices from it, and proceed to reproduce their kind. The female lac has an excellent appetite and grows rapidly, exuding a resinous substance which forms a shell-like covering. She soon loses her figure, and in the almost globular shape she acquires are three holes from which protrude long whitish hairs through which she breathes. These many filaments give the lac twig its characteristic white appearance. After fertilization the female contracts, leaving enough room in the half-inch long cell for her eggs. Upon emerging, the young insects are but 1/25 of an inch long and look like red dust. They are adventurous in disposition and wander along the twig for the best part of a day to find suitable feeding grounds and a place in which to start their own colony.

Red dye, which is a by-product, was used in the first century; and the use of lac resin mixed with pigment is reliably accredited to Akbar, the great emperor of of Hindustan, in the sixteenth century. It was exported to Europe early in the seventeenth century.



ORIGIN OF LACQUER

The lac insect *(Tachardia lacca)* is by no means the only scale insect commercially valuable. Another is the cochineal insect discussed opposite.

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SILK was used in China 4500 years ago, and in Greece in the time of Aristotle; but in the Occident it might almost be classed as a modern fabric. There have been attempts to promote the industry on a large scale in various countries, but the main source of supply is still the Far East. In China and Japan, and to some extent in India, the raising of the silkworm is an exact science, with intricate machinery to produce the finished fabric. Silkworms are also given tender care in homes, where their culture by farmers' womenfolk adds to the family income.

The weaving worm is a stage in the life cycle of *Bombyx mori (left),* an ashy-white, fuzzy moth. The female lays numerous eggs which hatch into rapidly growing worms; these feed voraciously on their favorite food, mulberry leaves. The small worm eats and eats until it reaches a state of lethargy, when it moults its skin and starts again. After the fourth shedding it reaches its maximum growth of about 3½ inches, the feasting and growing having taken about four weeks.

The creature's next interest in life is to build a cocoon for shelter during its pupal period. The worm has two glands, one on each side, running the length of its body, which join in an opening through the underlip; and from this orifice the valuable liquid is exuded which hardens as the air touches it. The worm spins and spins, moving its head in a figure-eight track, until its cocoon, containing up to 1000 yards of unbroken thread, is completed. This takes about three days. Then as a chrysalis, it takes a well-earned rest—or expects to. But man disposes of its industry otherwise; the cocoon is treated to soften the hard outer shell, and the fiber is reeled off, ultimately to become silk thread.

For breeding purposes, selected cocoons are saved to complete the life cycle.

The dark faun-colored tussah silk is produced by the worm of *Antheraea mylitta,* and there are numerous other spinners which produce commercial silk of different grades.

THE SILKWORM

One thousand yards of unbroken filament in three days

FACTORIES

By Olive Earle

COCHINEAL INSECT

In Grandmother's young days, pink icing on the cake meant a few drops of red coloring derived from the cochineal insect. Though its use as a dye dates from the time of Cortez, it was not until the early part of the eighteenth century that scientists knew that the grain-like object from which the dye was extracted was not the seed of a plant. This was hardly popular knowledge until the dye itself was superseded almost completely by artificial colors.

As with the lac insect, it is the female cochineal which is the factory. She is wingless and twice the size of the winged male, who has but one mission in a life that must of necessity be brief, for he has no feeding mechanism. The females, which greatly outnumber the males, spend their lives gluttonously, and swell until they look more like downy, brownish berries than insects. The cochineal is a good mother and protects her eggs until they hatch.

The cochineals live and thrive on several types of cactus (the one illustrated at top is a prickly pear). Three times a season, the insects are brushed from the plants or picked off with a blunt knife and killed by immersion in hot water, then dried in the sun. It is a tedious business, for it takes some 70,000 of the fat living insects to make one pound of dried ones.

The next step is the dye factory. Mexico and Peru are the main centers of what is left of the industry. Wild cochineals are sometimes used, but they are smaller than the cultivated insects.

The kermes, a scale insect found on oaks, was used up until the sixteenth century to provide red dye for fabrics and was also thought to have medicinal properties, but was superseded by the cochineal, which has been cultivated in the Mediterranean countries.

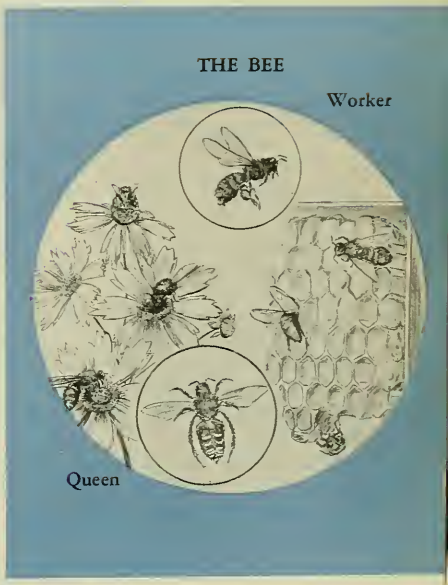
•

Piero Di Cosimo, artist of the Renaissance, in his picture *The Discovery of Honey,* gave credit for the discovery to Pan, the woodland god. From time immemorial the industrious bee has been a provider of sweetness for man. Whereas formerly the wild bee was hunted for its honey supply, now scientific beekeeping has perfected methods for producing a real harvest with the minimum of effort for all concerned. But man has not needed to change the bee's collecting habits, which seem to be most efficient. The worker bees are fitted with proper tools for their trade: a long extensile tongue, hairy and hollow with a spoon-like tip for collecting nectar from flowers; and a storage cavity or "crop" for transporting. Instinct plays an extraordinary part in the bee's activities and enables it to travel from blossom to similar blossom until laden, and then to make a "beeline" home. The nectar is disgorged in the hive, where it undergoes the completion of the ripening which began in the bee.

The young bees, when in the larval stage, are fed on beebread made from honey and the pollen of flowers; this also is collected by the workers, to whose hairy bodies it sticks. Brush-fitted legs clean it off and pack it in a pollen basket formed by long hairs on the rear legs.

The wax exuded from plates on the underside of the bee's abdomen has important commercial uses. It is used variously in modeling materials, candles and ointments. The bee, in building the comb, masticates the wax and applies it to form the honey cells. As the cells are filled, these skillful construction engineers cap them over neatly with more wax.

The drones do nothing except enjoy the fruits of the workers' labors and perhaps speculate as to which one will win the queen on her nuptial flight. The privileged one's honeymoon is terminated by immediate death; the others are allowed to remain in the colony until the close of the honey season, when they are summarily turned out by the workers, enough of whom survive winter to start work anew with the coming of spring.



THE PELICAN'S FAMILY

Celebrated by virtue of the large sack beneath the bill for carrying food, the pelican is one of the quaintest and most interesting sea birds. The brown pelican shown here has a wing-spread of six feet and obtains its food by diving straight down into the water when schools of fish are sighted. This aerial plunge, performed gracefully by a bird of such bulk, makes a surprising spectacle.

Most of these photographs were made on North Island, 75 miles southeast of New Orleans, where one of the largest pelican nurseries to be found anywhere is located.

This species of pelican is the state bird of Louisiana. The pelican is strictly a maritime bird and individuals occasionally stray as far north as the New England coast. They range south to Brazil.

The pelican has long been revered in mythology, and it figures in church and fraternal history. A favorite legend is that the parent pelican, when distressed by food shortage, will tear its own breast to feed its young with its blood. However, observations at the breeding islands off the Louisiana coast, or for that matter at any other pelican refuge, will convince one that this myth has no scientific basis.

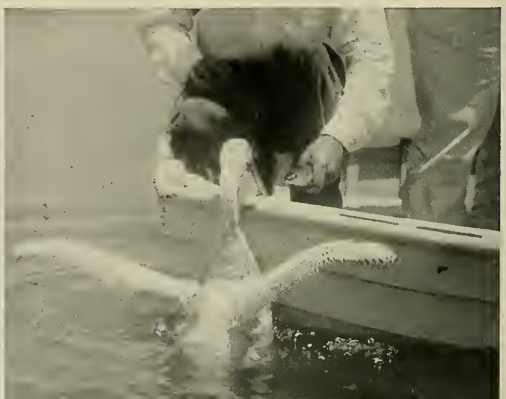
1 THE CRUDE NEST of the brown pelican, made of marsh vegetation, is built a few feet above the adjacent water from which the parent bird harvests the food for its young. Three or four chalk-incrusted white eggs are laid. They are the size of common goose eggs

2 *(Above, right)* AS CANDIDATES FOR UGLINESS, the baby pelicans are well in the lead. The bill of the pelican, which "can hold more than his belly can," is already prominent at the age of two days

3 *(Above, right)* A SOFT COAT OF DOWN protects the young bird. The rookery is a lively place, and these young birds, three weeks old, raised quite a fuss at the cameraman before he could catch this dignified pose. The noise which young pelicans make is short-lived, as upon reaching maturity Nature deprives these strange birds of all their vocal powers

4 THIS BABY PELICAN became lost from its nest and fell into a lagoon at a tender age

5 *(Below)* ITS PIN FEATHERS became wet, as it swam toward the photographer's rowboat, tempted by a succulent mullet



ALBUM

A Picture Story
by
ANTHONY V. RAGUSIN

6 FIVE POUNDS OF FISH a day is the average consumption of a pelican at the age of one month, but this food is largely of no commercial value in fish markets. Note that its primary feathers can now be seen as it spreads its wings, perched atop the mangrove bushes on North Island

7 *(Above)* THREE PELICANS waiting for their lunch. Pelicans in this region feed chiefly on menhaden, or Gulf sardine, a small fish containing much oil. Thousands of vigorous young pelicans fly forth each year to lend animation to the southern shores of the United States

8 FULLY FEATHERED and almost ready to fly: a scene in a North Island lagoon, showing thickly grown shore

9 ON THEIR OWN: master fishermen of the air. The webbed feet, useful in swimming, are retracted in flight

APOSTLE OF THE BIRDS

The life and times of Frank M. Chapman

By D. R. Barton

It is difficult at this bewildering moment in the sorry scheme of things to discover one among us who has never felt doubt for the simple values of his childhood philosophy. Surely the times do not favor such a faith. Yet in the being of Frank M. Chapman we find someone who is a little beyond and, I think, a little above our times and our customs. Out of a life-long devotion to birds he has created on the corner of 81st Street and Central Park West in New York City what has been called the "ornithological center of the universe." He has seen a paltry collection of 300 specimens grow into the hundreds of thousands, and he himself is one of those *rarae aves* whose life bestrides and epitomizes a long and momentous chapter in our national development.

At eight he played hide and seek in trenches freshly gouged in the Georgia soil to block the advance of a certain General Sherman. Later, on the way to his first Mexican expedition, he gazed across the sun-boiled Caribbean on a ship riding at anchor in Havana harbor. The red and gold of royal Spain fluttered above gray Morro Castle. The ship was Spanish; the railings crammed with troops. "Most of them young boys, 18 to 20 years of age." He was witnessing the prelude. Not many months thereafter those same blue waters closed over the decks of the U.S.S. *Maine.*

These years between wars were his coming of age. Thenceforward his career, like that of the nation itself, soared to an apex in 1928. Of that *annum mirabilis* he writes: "When on the morning of October 1st I looked at my *Times,* the first words to catch my eye in large type boxed at the top of the page were Hughes, Chapman, Lindbergh to Receive Roosevelt Medals. . . . I read the heading twice before I identified myself with 'Chapman.' "

But it was the same Frank Chapman, bracketed now with a world-famous jurist and a national hero who had arisen from apparent mediocrity almost literally on the wings of the birds he loved. For birds had fulfilled an essential of his nature. They provided an indispensable *élan vitale.*

In the beginning was a small boy. At a Baltimore school they taught him history from a text which referred to northern armies as "the Enemy." This

Kaiden-Keystone Photo

Frank M. Chapman

was a little hard on a born Republican and the son of a Union soldier, and even after returning to his native New Jersey he never lost his hostility toward text books, however innocent they might be of sectional loyalties. He freely admits to having been among the least distinguished students in his class at Englewood Academy—a future Doctor of Science, Museum Curator and President of the American Ornithologists' Union, yet indifferent university material. Rather he preferred the woods and unspoiled fields so abundant in what was then a district of gentleman farmers. Today he recalls with clarity and affection the sympathetic environment of his youth spent amid generous Victorian surroundings: the barn and hayloft, the stout limbed fruit trees on his father's property. Aloft in these trees, young Frank Chapman discovered the two phenomena which were to be his greatest sources of pleasure. The first, of course, were birds; the second, speculative solitude.

In his sixtieth year, Doctor Chapman made his initial visit to the winter hideaway on Barro Colorado Island that has since become famous in story and lecture as the "Tropical Air Castle." But this was simply boy become man. The first air castle was built in an Englewood cherry tree, and here developed a kinship with birds and with nature in the large that grew steadily with the years.

Soon there were other air castles albeit temporary structures, in Florida, Cuba, Haiti, Mexico, the British West Indies. In all these the boy, older now and screened by a foliage far different from Englewood's, kept watch with the same fascination for the intimacies of bird life. But the path to these lofty tropical perches had not been easy. Ornithology as a hobby was fairly well known in 1880. As a profession, however, it was unheard of. Pocketing his academy diploma, young Chapman, for lack of better, followed the well-trodden trail into lower Manhattan and the legendary world of the Jim Fisks and Jay Goulds. But this had small romantic appeal for him. Ensconced in the city collection department of the American Exchange National Bank, he commenced the drudging commutation between Englewood and his clerk's desk.

While his duties became increasingly responsible, he cared little for the work and sought the company of birds and bird men during every opportunity his meager leisure time allowed. Reminiscing on this period in his *Autobiography,* he recounts the founding of the American Ornithologists' Union speaking with hushed respect of the great pioneers of ornithology with whom he rapidly came more and more into contact—Elliott Coues, William Brewster, Dr. A. K. Fisher, his "ornithological godfather," and many others. For all of these he feels the same reverence which was later to be accorded himself by rising young workers in the field.

It was about this time that a prize was offered for the best paper tracing the migratory movements of birds in various sections of the country. The prize for the Eastern Seaboard was awarded to a young bank clerk who was, of course, Frank Chapman and who accumulated nearly all his data from sundown to dark and between

daybreak and the parting whistle of the 7:30 a.m. train at West Englewood station! This involved rising before dawn to tramp the neighboring woods via a route planned to bring him to the station just in time to catch his train. After a full day of office work and a second hike through the woods, he spent the evening preparing his specimens and recording all the circumstances under which they were collected.

With the award of the prize, America lost a banker and gained an ornithologist. He stayed on at the bank, but one day came a curious revelation. "I had gone to the Union Trust Company, then at the corner of Broadway and Rector Street, to collect a draft. While waiting, I saw a man whom I did not know, but whom I recognized as a messenger of the First National Bank. I can visualize him now with photographic distinctness. . . . He, too, was waiting, but while he waited he wrote on a pad he held in his hand and it seemed to me that what he wrote had no connection with the business of the First National Bank. Rather did he look like a priest who, while acting as a bank messenger, was living the life of a student. Perhaps there was sufficient resemblance in our relation to our vocations to make him . . . appeal strongly to my attention and imagination; and as I looked at him there suddenly sprang into my mind with the force of a revelation a determination to devote my life to the study of birds."

In these days 14th Street was the shopping center of New York City. On a corner of this thoroughfare Frank Chapman spent part of several lunch hours recording forty different species of native birds disported on the headgear of fashionable women shoppers. It was volunteer work undertaken as part of the first broadside fired by organized American ornithology in their ultimately successful war against this phase of bird destruction.

The Museum

In the Fall of 1886, Frank M. Chapman resigned from the bank to take up additional volunteer work on the top floor of the American Museum of Natural History. Here began a relationship by which both the man and the institution were greatly to benefit. He had first entered the Museum in the company of an amateur student of birds' eggs who had gained permission to work at the Museum on Sunday. At this time the Museum was always locked on the Sabbath—a fact which shocked Frank Chapman, recognizing as he did that this was the only day available to the majority of city people in search of Nature-lore. It is significant that today the Museum is open every day in the year.

A few days after the famous blizzard of '88, Frank M. Chapman was regularly employed as an assistant to Doctor Allen, then Curator of Birds and Mammals. When the snow cleared, he found himself working on the fifth floor of the first, oldest and only unit of the present Museum then standing. Aside from the 81st Street El station with its steam locomotives, hardly a single structure impeded one's view for miles around. Approaching eastward from the Hudson River, a pedestrian encountered an astonishing number of goats grazing in the region north of 72nd Street and Amsterdam Avenue. These goats have, unhappily, now vanished and Doctor Chapman is forever chiding the short-sightedness of his friends in the Mammal Department for their failure to immortalize a single specimen in the Museum.

DRAWINGS BY IRWIN WEILL

Owing to the scarcity of curators, Doctor Chapman was himself something of a mammalogist—his official title being Assistant Curator of Ornithology and Mammalogy. But though he collected mammals on most of his early expeditions, he left the large share of both mammalogy and technical ornithology in the able hands of Doctor Allen. What interested Frank Chapman was indoor portrayals of natural bird life. He has never ceased to approach the Museum from the point of view of a bird-lover seeking knowledge of local forms. Mindful of his own first visit when he had been discouraged by an unfamiliar swarm of foreign birds, he proceeded to remedy this situation during his early years on the staff. The result was the "Birds Within 50 Miles of New York City," an exhibit which was and is to this day an accurate pictorial census of month-by-month changes in the bird population.

With this as a beginning, he pressed toward his goal, which has finally been attained in the magnificent sweep of bird exhibition halls one sees today in the Museum. All these in large measure are the dreams of the young Assistant Curator of the '90's come true. But before the vast program of life-like habitat exhibition could get under way, it had to have the official approval of that revered autocrat, Morris K. Jesup, then President of the Museum.

The first habitat exhibit—the Cobb's Island Group, which still may be seen in the Hall of North American Birds—had just been completed. Would it be the last or the first? Anxiously Doctor Chapman awaited the effect of its unveiling before a Museum president who indulged his personal dislike of snakes by forbidding the creation of a Herpetology Department. President Jesup who had been ill was wheeled before the Cobb's Island Group. He stared, then in his booming voice proclaimed, "That is *very* beautiful." It was a signal to proceed. From that day to this Doctor Chapman has always sought to make Nature as vivid an experience for the visiting public as it has ever been for himself.

But it is not alone on his trail-blazing efforts in the realm of bird display that Doctor Chapman's unrivalled reputation rests. Concentrating chiefly in Central and South America, he has devoted years to painstaking zonal

analyses which, together with his classical work on the birds of Eastern North America, have laid the broad foundation for scientific work on the avifauna of this hemisphere. He has climbed the Andes on the backs of recalcitrant mules, charting the astonishing territorial divisions which this peculiar topography has fostered. Here in the course of an hour's climb you may see a transition in foliage and bird life as sharp as though you had taken a rocket ship from Panama to Ontario. It was possible to sit in the saddle, barometer in hand, and predict to the moment where one zone would end and another begin. Working in this region Doctor Chapman and his companion, Louis Agassiz Fuertes, were able to bring back immensely valuable data on the influence of climate, altitude and other geographic factors on the origin and distribution of hundreds of species. It was field work of a type that could have been carried on in few other places on earth and it set a precedent which Museum expeditions are following to this day.

Previously Doctor Chapman's Trinidad researches had been of great value to his brother scientists in the field of geology. Through a careful examination and comparison of the bird life of Trinidad and other islands close to the South American coastline, he was able to offer definite proof, where none had theretofore existed, of connecting links between the islands and the mainland. Geologists were thus enabled to chart for the first time a hypothetical definition of Caribbean land formations in ages long past.

These field experiences have had their summing up in many monographs and in 15 books which have sold altogether upward of a quarter of a million copies. The first of these was dedicated to his mother who was ever a source of inspiration to him, and the third book to his wife, whose natural skill at preparing specimens always astonished her husband while aiding her in becoming his helpmeet in the field as well as at home.

Among many pioneer investigations which Doctor Chapman has conducted in his own continent is his graphic inquiry into the origins and distribution of the Grackle. This exhaustive study is still going on. But sufficient detail has been assembled under his direction to strongly indicate that the Grackle, which today occurs in several hues, was originally only purple. The gradations took place, apparently, owing to ecological factors resulting from the profound changes since the glacial age. No reference to Doctor Chapman's Grackle study can well pass without mention of the curious fact that, due to city ordinances, the most difficult specimen to secure lived right under his nose in Central Park. A keeper in the Zoo was finally allowed to trap one for him.

The ethos

Such, in bare outline, are the more notable of his achievements in science. But it was not for these that on the evening of October 27, 1928 he was bidden to the birthplace of Theodore Roosevelt, formally to receive the medal for distinguished service. Like the young aviator who was also honored, his award was made less for specific attainments than "influence in the development of character." Whereas Nature had once interested thousands in America, it now interested millions, and Frank M. Chapman, by his life-long advocacy of the birds, had figured preeminently in accomplishing this "profound change in our habits of mind"—had, indeed, been called the most influential since Audubon.

One evening many years before this consummate occasion, before, in fact, he had yet acquired the self-possession that comes with popular recognition, Frank Chapman was called upon to ascend a lecture platform. It was the young statesman's maiden speech, the budding actor's first "walk on," attended by all the anguish of stage fright germane to such debuts. It was indeed worse. For an exponent of the obscure and at that time defensive profession of ornithology is seldom endowed with the temperament for public appearance so implicit in the theatrical aspirant. In every sense this was an hour of trial, and the young assistant curator well knew that if he could not overcome his natural shyness, the gospel of the birds would, so far as he was concerned, remain unpreached.

It was a winning struggle as anyone who has seen Doctor Chapman's poise on the platform can easily bear witness. But this later mastery of public presence he attributes in part to a curious resolution made as he turned to face that first audience. Up to that moment he had always thought of himself as an advocate for the birds, pleading their cause in the presence of his own race. But then, in order to place himself completely at ease he resolved mentally to transform his human audience *into birds!*

We can now surmise what thoughts passed through a small boy's mind as he lay by the hour not three feet from a warbler's nest high in that cherry tree air castle. Later we perceive the same spirit of intimate communion when he wrote of a tree-top experience in the British West Indies: "Thirty-seven years passed before I again heard Poor-me-one (meaning in the language of the Trinidad Negro, 'Poor me, all alone'). Then I found it in the forests of Barro Colorado Island. . . . A very simple song of six full notes slowly descending the scale, each an interval apart. But notes of such richness of tone, so suggestive of sorrow, that in all the world of birds or man I have heard none sweeter or sadder."

Nor can we doubt that his thoughts are essentially the same today. He has patterned his life so closely to the birds that like them he is now a migrant to southern climes, and even as these words are read, has rejoined their company in the solitude of his tropical air castle. He knows a great deal more about his bird companions now, can

watch with an eye ever more discerning, but always it is the special beauty of the contemplation and the feeling of identity that is his ultimate satisfaction. This underscores all of his more tangible achievements, infuses them with a flavor peculiarly their own, and is perhaps the greatest among them.

It is in itself a precious achievement —this capacity for identification—and, significantly, most readily found in the realm of poetry. Ask of Doctor Chapman, "Who were our first ornithologists?" and he will answer, "The poets. We owe much to the poets." And he will tell you that as far back as 300 B. C., Aristophanes exclaimed, "But of late, birds are all the fashion." This is his favorite quotation. It stands as a succinct reminder of the immortality of those creatures which he believes to be "the most eloquent expression of Nature's beauty, joy and freedom." That these, his alter-egos, should forever be "all the fashion" is his own *raison d'être* as well as that of the great Bird Conservation movement in America, of which he is, one might say, both a founding father and poet laureate.

His life has spanned the birth and development of the American Ornithologists' Union, and the Audubon Society, and his career reaches so far back into the natural history of their origins that he has come to appear as a kind of intergrade form bridging the transition between poet and the fact-minded morphologist of the laboratory. Like Shelley—who produced some of the greatest English poetry through self-identification with a gale of wind, a cloud, a star, and yes, best-known of all, a Skylark—Doctor Chapman has the rare gift of expressing Nature with scientific accuracy inseparably joined to a sublime feeling for his subject. Much that he has written has been a kind of evangelical introduction into the charmed circle of creatures that soar and sing. These have meant more to him than any other contact with the world, and through his teachings numberless empty lives have found new joy in the same ethos.

A few of these have followed him into the profession of ornithology. But this is a step he is not quick to encourage. Whatever the environmental psychologists may have to say about identifying oneself with the birds. Doctor Chapman is convinced that it is a special gift. You cannot acquire it. Rather, it is something born in all true ornithologists. Doctor Chapman knows that Man's interest in Birds is as old as Man himself and he has observed that in each of the many primitive tribes he has met during his expeditions, there was always one outstanding "ornithologist"—a native who instictively learned far more jungle bird-lore than his fellows. "If I could trace back my ancestry far enough," he says, "I feel sure that somewhere I would find just such a primitive bird man." Accordingly, Doctor Chapman has a little test by which a young devotee may judge whether or not he is good ornithological timber. He simply says, "Don't be an ornithologist if you can help it. Try your hand at anything or everything else. Then if you really *must* be an ornithologist—you will be. And under almost any circumstances, you will be happy."

But Doctor Chapman is ever eager to encourage bird hobbies in anyone. His own transfigured love of ornithology has been imparted to millions of human beings from humble nobodies to great scientists and even kings. And they never forget him. Last summer Frank M. Chapman was 75 years old. At a surprise birthday party held in the Museum he was presented with a leather-bound collection of the hundreds of letters which friends all over the world had secretly written for the celebration. As illustrative of his abiding influence, and with its author's kind permission, we reproduce one of them here:

"Dear Dr. Chapman:

"Some ten years ago this pathetic derelict—let's call him B, entered the sanctum of the Dean of American ornithologists on the fifth floor of the American Museum. Jobless, not yet 40, this one-time member of the New York Stock Exchange, had nothing in the world to occupy him. He had a slight knowledge of mammalogy (bulls, bears and lambs), but it was highly specialized. He knew nothing about birds: could he learn? Could this flotsam and jetsam of Life's stream be retrieved? Could he start anew! Ornithology must be begun while still in swaddling clothes—the whole world knows that. But undismayed, the Dean, let's call him C, advised and encouraged B. "Go up to Ithaca; study under A, and you may yet be an ornithologist," he said cheerfully. B took his advice as many another aspiring bird man has. It was the turning point of his life. He left the sanctum whistling and singing. He has not stopped to this day!

"Moral: If you want to be a bird man, go to headquarters, and follow the dictum of the greatest encourager of youthful, middle-aged and venerable would-be bird men. See C!

Albert R. Brand."

COMPOUND OPTICS, *head of a dragonfly*

WILD BOAR AND BABIES

Seeing Nature *through* THE CAMERA'S EYE

BURSTING BITTERSWEET

By HENRY B. KANE

in 1882, in the jail yard at Carson City, Nevada, where they may still be seen. The Kleg-E-Toh tracks have been presented to the American Museum of Natural History.

Having returned with these specimens to the railroad, Sam and I took to the road once more; this time in search of the Sacred Cave. Sam had danced in all the Navaho dances, and knew all the ceremonial songs by heart. The dance-ceremony called "The Night Chant" is the story of Navaho theology. It tells how the Sun God, Jo-Who-Na-Ah-E, sent a messenger to earth. This messenger and his attendants (collectively the Yea-E-Be-Chi) came "from Beyond," and made a circuit of the Navaho world, visiting first the San Mateo Mountains in the east, and then, in clockwise order, the White Mountains, the San Francisco Peaks, and finally the La Plata Mountains.

From the La Plata Mountains, "The Night Chant" describes a visit to a Sacred Cave, following which the Yea-E-Be-Chi went next to the "White House," a celebrated ruin in Canyon de Chelly, and thence east again, back "Beyond." In the Cave the Yea-E-Be-Chi left a written record of the Sun God's teachings, the interpretation of which was entrusted to the medicine men. Although described in detail in "The Night Chant," the location of the Sacred Cave could not be fixed anywhere in the Navaho country.

Sam knew the full ritual of "The Night Chant." He knew his way in Navaho country. From one of the oldest medicine men he had received a tip. With this data, we headed north from the railroad, north of the Canyon de Chelly to search for the shrine of the Sun God messengers. We entered the Lukachukai Mountains in the extreme northeastern corner of Arizona, a wild region, rarely penetrated by travelers.

Mystic valley

Beyond the dry brown flats of the Chin Lee Wash, the mountains rose in a long series of bright red cliffs, topped by green pyramids zigzagging into the turquoise sky. Sam drove the car across the wash and up a series of arroyos leading to a break in the red battlements. We passed two enormous sentinel buttes, and entered a narrow valley: Do-Yah-Kay-Ah— "the wonderful, the mysterious, the mystic place." This was the valley of "The Night Chant," the valley of the Sacred Cave. On either side of us rose the silent red cliffs. A tortuous and deepening arroyo allowed the car to carry us on. The valley narrowed and darkened. As the sun set, enormous shadows turned the red eastern cliffs to black.

We came to a solitary hogan where lived an old woman, and a little boy who tended sheep. Sam spoke with her and showed her the sacred token: Ta-De-Deen-Bi-Ziss, the pollen sack. He said that we had heard "The Night Chant" sing of the Sacred Cave and had come to offer pollen to its gods. The old woman let us pass.

About a mile up the arroyo, beneath a huge sandstone pinnacle in the form of a dog's head, we made camp for the night. Around the campfire Sam told again of the Cave: Yea-E-She-Jay-E, "the place where the Yea lie."

After sunrise and breakfast we scrambled out of the arroyo and examined the valley walls. Within our view were three huge caves, one of which seemed to fit the specifications of the song. We climbed up over sprawling mounds of drifted sand to the gaping mouth of this cave. It was in the form of a giant band shell, whose vaulted roof was some hundred feet high, with arching pillars about 300 feet apart at the base. The depth was about 100 feet. The cave floor was uneven, formed by the flaking off of big sandstone slabs from the roof. Covering the backwall was a long series of mural paintings, made up of hundreds of designs, figures, and handprints. These symbols stood out in brilliant colors—orange, red, light green, blue, and lavender—all against the red monotone of the sandstone wall. Most numerous of all the symbols were the handprints usually in pairs, always with the fingers pointing up. These prints were about the size of a rather small adult hand and had evidently been made by first smearing the hands with pigment and then pressing them firmly against the cave wall. In some cases the lines of the imprinting palms could be identified. A few footprints were present, usually small, as if a baby had been held up and its feet pressed against the walls. Tiny outlines of human figures, zigzag lines that might have meant either snake or lightning, and intricate symbols showed up here and there in the maze of handprints.

Sacred quaternity

Below a prominent shield-like device of wavy green lines and four pairs of green hands, our eyes were guided downward by a vertical green line to four objects lying on the sand against the backwall of the cave. These were the Yea, four identical effigies made of gray clay, in the form of human face masks, about a foot in diameter, into which had been cut a geometrical pattern of eyes and mouth with molded nose between. In the mouth-space were the rare remains of turquoise teeth. Around the periphery were multiple small holes from which protruded the stubs of reeds. These reeds, said Sam, once portrayed the

sun's rays, and these four clay images were the symbol of the quadruplicate Sun God, Jo-Who-Na-Ah-E. His four parts were four manifestations of a totality, in the same manner as our own Trinity.

The images lay with their chins resting in the sand; before them were fragments of shells, beads, and turquoise. We sprinkled some sacred pollen and gazed at the gods. What lay hidden under the sand beneath their chins we do not know, for we felt an obligation to refrain from touching anything in this cave. We saw it not as an archeological relic, with only academic interest to distant scientists, but as a living part of the present-day Navaho religion. It is the object of the medicine man's pilgrimage. The worn edges of the floor rocks betray the many feet which have come here in years past. It is the place where the gods left their eternal message to men. Here are the very handprints and inscriptions of the Yea-E-Be-Chi.

Message of the gods

The Navahos recognized that the symbols in this cave were not made by their own people and ascribed them to the gods. The pigments used are unknown to the present Indians. Near the mouth of this cave, we found pieces of a broken bowl, subsequently identified as belonging to "Pueblo III" (about 1000-1100 A. D.). Across the valley from this cave we found, in a second cave with similar paintings many well-preserved Pueblo ruins. From such evidence we postulated that the symbols of both the caves had been made by the pre-Navaho Pueblos.

After making a complete photographic record of the cave walls, we sat down in long and silent thought. Here was the present Indian mind and heart still in emotional contact with the art of primitive man. Here was the handprint of a thousand years ago still telling a 1939 medicine man the answer to a current problem. Here was the pictorial story of "The Night Chant," the story of the gods and their way with men.

We left the cave. Back at the hogan, the old woman asked for the story of our visit. She told us that two medicine men had come up that morning to worship at the shrine but had turned back on hearing of the white men there. We assured her that we had disturbed nothing, and had taken nothing away but pictures. Might I take her picture? No, she did not want to leave her hogan and she knew that my camera would bear her image far away. We promised her to keep the secret of the cave, to disclose its location to none but those who would come bearing the sacred pollen in their buffalo sacks and reverence in their hearts. Do-Yah-Kay-Ah would remain what it always was—"the wonderful, the mysterious, the mystic place."

Why haven't I been told . . . ?

This is the common complaint of thousands of persons who by chance have come across NATURAL HISTORY MAGAZINE. The American Museum is eager to bring attention to the opportunities of membership, its nominal dues and its beneficial privileges, including NATURAL HISTORY MAGAZINE. You or your friends are cordially invited to become an integral part of this great institution and enjoy its benefits.

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ART EXHIBIT

In Education Hall, American Museum of Natural History

The Work Projects Administration announces the opening on January 8th of an exhibition of painting, sculpture, prints, plates from the Index of American Design and photographs by artists of the New York City WPA Art Project. These will be shown through January 30th.

THE ESKIMO GOES MODERN

Continued from page 39

kies!' " Sid chuckled. "I looked out of the window and there were those two confounded Huskies parading to church as proud as Lucifer, and all they were wearing was a big grin, a suit of combinations and a pair of mukluks. Thought they were all dressed up!"

I heard other stories from Corporal Walters, who had had charge of these same two Huskies down at Resolution. When he went to Mass on Sundays he would leave the two murderers to look after his kiddies. They'd dress the children and get their breakfast for them. They'd noticed that the Corporal always brushed his teeth. Imagine Walters' surprise when, dropping in on them unexpectedly one morning, he observed Sinissiak brushing his teeth with a toothbrush. When he was through he passed the brush to Uluksuk, who followed his example. But where could they have obtained the toothbrush? Suddenly Walters burst out laughing. They were using an old toothbrush he employed for putting polish around the edges of his boots!

But Pokiak, the medicine man at Aklavik, beat them all for ingenuity. Hearing that a missionary at Shingle Point could cause the moon to enter and leave his house at will, he decided to do something about it. Here was strong medicine, indeed, stronger even than the white man's reputed ability to project his astral body through the ether to find out what was going on in other parts of the arctic. Loading all his available white foxes upon his *komatik*, Pokiak paid a visit to the missionary. Ready, like every Eskimo, to learn by another's example, Pokiak's fifteen by eighteen foot driftwood igloo is now lighted by electricity from a Delco lighting system installed therein. And to the open-mouthed Huskies from along the arctic coast he now demonstrates his power to bring the moon into the room or banish it at will.

But for sheer pathos take the story of Uktook, who fell in love with a picture. His favorite literature was the Sears, Roebuck Catalogue over which he pored at every free moment. One day he decided to order something. And—talk about selling iceboxes to the Eskimos (machines which, incidentally, they could use very nicely in the summer)—what Uktook wanted was a fur coat, a lady's fur coat at that. No one could reason with him, and the order blank was mailed south. Uktook waited with the utmost impatience. Then one day the coat arrived, perfect in every detail, but Uktook was the most crestfallen man in the North. The beautiful lady he'd seen inside the coat just wasn't there!

DO NOT MISS

How old is cancer in the history of animal evolution? What different forms of life does it affect? Not long ago scientists noticed that certain tropical fish in home aquaria developed strange tumorous growths resembling a vicious kind of human cancer, and that their tendency toward this was inherited. Did the condition exist in the wild? Myron Gordon, an expert geneticist, led explorations into the jungles of Mexico to find out. His discoveries will be narrated in **THE FISH THAT WAS JUNGLE-BORN AND CITY-BRED.**

In recent years a great deal of illumination has been shed on the Dark Continent and rare is the tribe that has not frequently played host to a white expedition. Yet Julie B. Morse managed to pass beyond the natural barriers surrounding the Wa-Kindigas and thus became the first white woman ever to investigate these wild and amazingly shy primitives. Her story **WE LIVED WITH THE WA-KINDIGAS** will appear in an early issue.

In **CONFESSIONS OF A HUNTER,** Roy L. Abbott, whose warm understanding of animals is well known to readers of NATURAL HISTORY, will tell why you should know an animal before you raise your gun.

Despite the notorious **TRAP-DOOR SPIDER'S** gift for wily toils and stratagems, he has manufactured no defense against *Ocnaea smithi,* a tiny parasite which grows within his anatomy. Ocnaea's amazing career in the spider's body and out, will soon appear in NATURAL HISTORY in a dramatic photo series by George Elwood Jenks.

In **THE EDGE OF THE EDGE OF THE WORLD,** Gilbert C. Klingel recounts the ghostly beauty of life on the brink of a submerged cliff that slopes 7000 feet down into the unknown blue mists of the Bahama seas. Here, clutching the precious life-line of his diver's helmet, he fights off the poisonous tentacles of a Portuguese man-of-war, "stares down" a giant devilfish and "rubs elbows" with the deadly barracuda in order to bring back knowledge of Nature's most fantastic underworld.

The story of **THE TIGER OF JAVA HEAD** will be told by William Lord Smith. The animal was bigger than those on the mainland, they said, and fiercer. His capture came only after a long campaign planned in an isolated hut in the steaming tropical wilderness.

PHOTOGRAPHIC FEATURES

The amazing **FUNNEL-WEB SPIDER:** another Lee Passmore picture biography soon to appear in NATURAL HISTORY.

REARING A FAMILY OF THIEVES—extraordinary close-ups of magpie life from the first moment through the first month.

TRAIL SIGNS OF THE AMERICAN INDIAN. The signs are not only still with us, but growing bigger all the time!

The lordly **SPOONBILL,** a sensitive bird, is rigidly protected even from photographers. But the Audubon Society made an exception to allow Karl Maslowski to film the exclusive story of a rare and beautiful creature.

LETTERS

Continued from page 1

their cattalo which appeared in the April issue of your magazine.

THOMAS H. KNEPP,
Instructor in Biology.

Everett, Pa.

SIRS:

May I add that I find your magazine of the greatest interest and . . . if forced to take only one magazine, it would be NATURAL HISTORY.

J. CHARLES DAVIS, 2ND.

Los Angeles, Calif.

Concerning the Man-o'-War bird, which, though a master fisherman of the air, is relatively helpless on the surface of the water:

SIRS:

I have read with great interest Doctor Murphy's article on Man-o'-War birds in the October issue of NATURAL HISTORY Magazine.

While my schooner, the *Zaca,* was anchored in Conway Bay, Indefatigable Island, of the Galápagos group, and we were working in preparation for the bird exhibits in Whitney Memorial Hall, an incident occurred that may be of interest to your readers, since it shows that under certain circumstances a Man-o'-War bird *can* rise from the surface of the water.

One afternoon I saw a fine male Man-o'-War bird flying around the *Zaca.* Since Doctor Chapin wanted such a specimen, I shot this bird at long range, and it dropped into the water. About ten minutes later several members of the crew set forth in the tender to pick it up, but as they approached I saw the wounded bird face the light breeze and begin to beat its wings. It finally succeeded in rising from the water and flew away at a low level toward land.

The incident was witnessed by a number of us and there can be no doubt that the bird had actually succeeded in taking off from the water. Doctor Chapin believes that the species was the American Man-o'-War bird *(magnificens)* because the other species *(minor)* found at the Galápagos is rare in the Conway Bay district.

TEMPLETON CROCKER.

San Francisco, Calif.

Sirs:

I have just read with interest Carl C. Dauterman's article, "The Strange Story of the Stephens Stones," in the December NATURAL HISTORY Magazine. I visited all the Central American republics last summer and of course went to many of the ruins. In a shop window in Quetzaltenango, Guatemala, I saw copies of a new book, a Spanish translation of Stephens' *Incidents of a Trip in Central America, Chiapas, and Yucatan.* The bookseller told me that the work had just been translated by a small shopkeeper across the street. I did not get to meet the translator, but it is interesting that the Central American republics, almost a century later, have felt the need for a translation of this classic concerning their lands.

Dixon, Illinois. EUGENE B. VEST.

Sirs:

In the November issue of NATURAL HISTORY Magazine I was very much interested in reading the article, "The Pearl of Allah," by Wilburn Dowell Cobb.

The author refers to Dyaks in the Philippine Islands, and in my studies of native races of the world I have always been given to understand that the Dyak tribes are and have been confined to Borneo proper.

Being a profound reader of the excellent articles in NATURAL HISTORY each month, I should appreciate your comment on this point.

San Diego, Calif. E. B. POWERS.

Wilburn Dowell Cobb, the writer of this article, is a Malay and has spent most of his life in this region. His only white ancestor, he incidentally tells us, was an Englishman six generations ago who was taken captive by the Malays as a boy and brought up as one of them. This ancestor's name was also Wilburn Dowell Cobb, and his daring exploits are still common lore throughout the Sulu Archipelago. Concerning the Dyaks, he writes:

"In the southern half of the island province of Palawan, Philippine Islands, are several mountain ranges extending, one after another, in a southerly direction and ending in what is known as the Bulanjao Range, which runs almost as far south as Buliluyan Point, the southernmost extremity of the island. In these remote mountains, from the southern tip of which Borneo lies only a few hours away by motor boat, live several mountain tribes who call themselves Dyats or Dyaks, as similar mountain people are called who live in the mountains of British North Borneo. This secluded section is the only place in the Philippines where you will find true Dyaks. They speak and have the same tribal customs and practices as the mountain Dyaks of Borneo. They are believed to have been driven into the mountains by Malayan invaders. The word Dyat in old Malay means "people of the hills."

WILBURN DOWELL COBB.

Continued on page 62

YOUNG GREEN HERONS

Photographed at Montauk Point, Long Island, by Olin Sewall Pettingill, Jr.

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- - - - - - - - - - R. M. Lockley

D. Appleton-Century Co., $3.00

THE author of this delightful book has long since excited the ornithological world by his studies of the Manx Shearwater and other sea fowl on Skokholm, the little island with an ancient Norse name which lies off the coast of Pembrokeshire. Thither Lockley went some years ago, differing from Crusoe, however, in that his voluntary exile has been shared by a courageous and rejoicing wife.

Lockley writes with convincing and wholly unsensational charm, which stems first from the innate attraction of lonely islets for most human hearts, and second from his totally unfeigned closeness to a nature that has been able to keep largely out of the way of the heavy footfalls of what is sometimes called civilization. His narrative carries us through an odyssey of island wandering, which includes not only the outliers of the Welsh coast but also the Blaskets, west of the tip of County Kerry, the Orkneys, Shetlands and Faeroes, the Westmann Islets south of Iceland — last home of the Great Auk — and refortified Heligoland in the North Sea.

As Thackeray said of Dumas, the text is one that can be read with perfect contentment of mind from daylight until dark. The illustrations from photographs are in keeping, and the author has the artistry to weave through his story the thread of a quest for Leach's petrel (commonplace enough to many of us) in such a skilful manner that the bird acquires all the glamour of the Golden Fleece.

R. C. M.

FLOWERING EARTH

- - - - By Donald Culross Peattie

Putnam, $2.50

A MINUTE fact, when Donald Culross Peattie writes, is dropped into a lake of ramifications, where ripples, then waves draw as with a magnet other fragments until a vast horde of ideas have been amalgamated with the original. Thus he may take a chlorophyll cell of a desmid of the sea and build about it an ever-widening horizon until the green cell has been lost in an ocean of life; an ocean that is ever changing, billowing, scintillating, a fascinating ocean dependent on the process of photosynthesis carried on within a cell.

These elaborations of an idea are usually intriguing collections that give evidence of close observation and an omnivorous taste in reading which is substantiated by the extensive reference bibliography given at the end of the book. The delight of it all is that one never suspects where the web of thought will lead or terminate. This writer has been referred to as the Poet Scientist. Scientists may be of the opinion that occasionally he takes advantage of the allowance made for poetic license. Especially when he uses rather elastic phraseology with regard to some scientific fact which makes a statement encompass too much, as when speaking of *boleti,* (a group of fungi) he states "when you bruise them the color changes." That is true of some but certainly not for all members of that group. Nevertheless it is aptly stated on the fly leaf of the cover that Mr. Peattie "adds whole new dimensions to our appreciation of the life that lies about us."

Woven into the theme of the book; this unveiling of some of the intricacies of relationships of "Chlorophyll, the Sun Trap," algae, cycads, ferns, conifers, flowers, seeds and the "Web of Life" are the evidences of trails made by the author through many parts of the United States as he was gathering evidence for this three-dimensional discussion on plants.

The reader who has wide botanical understanding will no doubt profit most by the perusal of these pages. However, the novice too, should be innoculated with the urge to become better acquainted with those green plants which are the producers of life maintaining substances.

As is characteristic of the numerous Peattie books, *Flowering Earth* is written in poetic style with an added touch of personal adventure in his preferred science, Botany.

FARIDA A. WILEY.

AMERICANS

- - - - - - - - - - by Emil Jordan

W. W. Norton and Co., $3.50

FEW historians have had the temerity to stretch their canvases wide enough to accommodate within a single frame the story of both the Americas from aboriginal beginnings to the ferment of recent times. But after reading Mr. Jordan's *Americans* it is possible to discern in the history of the New World a pattern of repetition and contrast which lends a logical unity to the entire picture and to appreciate by the omissions how formidable a task a detailed account would be. Mr. Jordan has wisely not attempted to include all aspects of conventional historiography. His major purpose has been to trace the migrations of the varied hosts which came to these shores from the Old World and to high-light these movements with political and personal digressions. Beginning with a summary account of the arrival of the American Indian and a brief description of the life of a selected number of aboriginal groups, he proceeds to sketch in the nature and manner of the Spanish settlements and the colonization of North America.

Although Mr. Jordan offers nothing historically new, his impressionistic treatment of the whole story of American settlement does represent a rather novel treatment not ordinarly encountered in standard texts.

H. L. S.

A FIELD BOOK OF NORTH AMERICAN SNAKES

- - - - - - by Raymond L. Ditmars

Doubleday, Doran & Co., $3.50

DOCTOR DITMARS' books on reptiles have formed an impressive series and we are glad to welcome a new member to the family.

Advanced students of North American reptiles make frequent references to keys and distributional lists which rarely come to the attention of the casual student of reptile life. Doctor Ditmars in his new book attempts to appeal to both audiences by arranging his data in regard to reptiles in precise tables. Thus, under snakes: size, form and scalation, coloration, distribution, and habits are each considered succinctly. There is a chapter on the treatment of snake bites which is welcome in view of the recent innovation of suction cups in field equipment. There is a series of 48 plates at the end of the book. The specimens in these plates are arranged chiefly to show species characters and not to bring out details of posture. It is not always possible to show the characters of reptiles in photographs and a series of line drawings to accompany the text would have made identifications easier for the beginner.

This last addition to the Ditmars' family is the most technical of his group but it will nevertheless prove attractive and useful to even beginning students of reptile life.

G. K. N.

DANIEL BOONE

- - - - - - - - by John Bakeless

William Morrow and Company, $3.50

JOHN BAKELESS was born at Carlisle, Pennsylvania. His father was principal of the famous old Carlisle Indian School. The Bakeless family physician was a full-blooded Apache M.D.; and John Bakeless, reared by two Indian nurses, was the first white student ever to attend Carlisle. With this background, it is no wonder that the author became interested in Daniel Boone, wilderness scout.

After a prodigious amount of research,

he has given us a most readable and human biography—as thrilling as a Beadle Dime Novel, and yet a fully documented narrative. It is a satisfaction to note, however, that the acknowledgments, bibliography and notes are in the back of the book, where they do not at all interfere with the story.

It is all so gripping that every boy and every adult with a boy's heart who starts to read it will be sure to finish it. More than once the author notes the somewhat "queer, half-humorous fondness" for Daniel Boone cherished by the Indians. This admiration was certainly augmented by his running the gauntlet while a prisoner of the Shawnee Indians.

Audubon met Boone in the wilderness, and has given us a vivid account of this visit. A portrait by Audubon is the frontispiece of the book. Chester Harding, a wandering artist, who painted Boone's portrait, once asked the old scout whether he ever got lost. "No," replied Boone, "I can't say as ever I was lost, but I was *bewildered* once for three days."

CLYDE FISHER.

BIO-ECOLOGY

- - - - - - - by F. E. Clements and V. E. Shelford

John Wiley and Sons, $4.50

ECOLOGISTS frequently have questioned the conception of life zones based on temperature. This hypothesis was developed from experience in the United States, especially in the Southwest, but the principles do not fit conditions in the East to the same degree, nor do they explain the distribution of tropical and Old World animals and plants.

The authors of *Bio-Ecology* show that the conception of the biome, a plant-animal community of climax nature, is equally applicable to all continents and even the seas. In the Southwest the conception of the biome can frequently replace that of the life zone without involving much modification, since the latter is in practice described from its constituent plants and animals, rather than from isothermic criteria. Such a generalization is extremely valuable for ecological comparisons on a world-wide scale.

The senior author is a plant ecologist, the junior author has done most of his work with aquatic animals, but both have had experience in the complementary fields. The collaboration is especially valuable for this reason.

The major portion of the text defines and illustrates the principles of the united plant-animal ecology. The typical terrestrial or fresh-water biome consists of the plant matrix (vegetation), with the included animals. Marine biomes are chiefly zoöphyte communities with included free-living forms. This unit is a complex organism, greater than the sum of its parts. The authors discuss in considerable detail the common biotic functions of the biome: aggregation, or formation of groups; ecesis or establishment; succession; migration; reaction, the effect of the community on the habitat; coaction, the effect of organisms on each other; competition; and cooperation.

The second part of the book deals with three types of communities, communities about which enough is known to describe the processes of life and the characteristic life forms. The North American grassland is quite completely described; other chapters analyze several fresh-water biomes, those of Puget Sound and the North Atlantic. They agree essentially with the conception of the biome as applied to terrestrial communities.

An extended bibliography and numerous illustrations add much to the usefulness of this book.

JOHN ERIC HILL.

FLASH!

- - - - - - by Harold E. Edgerton and James R. Killian, Jr.

Hale, Cushman and Flint, $3.00

FLASH! Camera! Action! The everyday world that zips past us is now under control. We have watched a glass fall to the floor and break but never really seen what happens. A cat laps up milk—how is that done? We return a hard serve in tennis and split a ball. Why? *Flash* will show you the answers and keep you spellbound for hours. Motions that are little more than blurs to all of us have been "frozen" and made visible for the first time. Indeed, so visible that we almost reject them as tricks of photography.

Professor Harold E. Edgerton and his associates at Massachusetts Institute of Technology have perfected apparatus which permits photography at speeds greatly in excess of conventional equipment. In their laboratories, exposures of 1/100,000 of a second are commonplace and exposures at 1/1,000,000 of a second have become an integral part of the work. Such unbelievably short periods of time are made possible by a new flashing lamp capable of producing light of terrific intensity. The flashes of this lamp are controlled both as to duration and frequency of flashes. In this way inordinate speeds can be measured by the displacement of the image on the photographic film when the timing of the flashes is known.

The pictures in *Flash* are not stunts to catch the flitting fancy of the public. They are the means of analyzing motion from a scientific and an artistic viewpoint. Engineers in industry find the stroboscope a valuable and versatile precision instrument to measure velocities and to detect distortion or deflection of fast-moving machinery. Even the psychologist is resorting to Edgerton high-speed photographic equipment to study behavior responses and vocal cord movements, a field in which we know nothing. The artist will certainly appreciate the wealth of material adaptable to patterns and designs for textiles and wallpapers. Not until you have studied these results will you behold the beauty and the grace of movements that surround us and yet are never visible to the unaided human eye.

THANE L. BIERWERT.

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Boston

EXCURSIONS IN SCIENCE

- - Edited by Neil B. Reynolds and Ellis L. Manning

Whittlesey House, $2.50

THE thirty writers who have collaborated to build this book are all scientists, actively at work in their respective fields. Most of them are associated with the Research Laboratory of the General Electric Company. Their fields of authority cover a broad range of science; physics, chemistry, geology, zoology and astronomy are among them. The essays range between the first principles of some sciences down to the latest developments in others. Readers who have had scientific training will find those of the latter type more interesting, while the elementary reader will probably prefer the former group. All are worthwhile, whether read for new information or as a review of forgotten knowledge.

The introductory chapter, written by Dr. Irving Langmuir, a Nobel Prize winner and associate director of the Research Laboratory, stresses the fact that men are more important than equipment for the progress of research. Successive essays, which follow each other without any obvious relationship, discuss in a popular fashion such subjects as atoms, the concept of time, lightning, meteorites, animal light, Mars and molecules. The writers are experts in their lines, this is no attempt at interpretation by a popular author whose own concepts are none too clear. They are well written and easily understood. The editors have done a good job of assembling this series of radio addresses and arranging them for publication. They are of varying penetration; though some are superficial, the majority, especially those

emanating from the Laboratory, are up to date and vital. They make it easy, for example, for the layman to understand the purpose of the latest and largest cyclotron that he sees pictured in the rotogravure. Younger readers, whose imaginations need contact with the stimulating possibilities of research work as a career, will find these essays almost exciting, for the reader, himself, might be the writer of the next installment of the never-ending serial of laboratory exploration.

F. H. Pough.

The Life of the White Ant

- - - - - - - by Maurice Maeterlinck, translated by Alfred Sutro with a preface and illustrations from photographs by Victor Wolfgang von Hagen

Dodd, Mead and Co., $3.00

Sutro's translation was originally published in 1927. It is surprising that this reprinting, with the addition of a preface and illustrations, did not have the benefit of a technical editor who would have avoided such errors as the frequent (but not consistent) use of capitals for the initial letters of specific names, and the misuse of the words "genus" and "species" in the explanations of photographs.

In writing about termites Maeterlinck was more a philosopher and master of fine writing than an entomologist and master of science. The following are typical of Maeterlinck the philosopher and literatist.

"Its [termites in general] own weapons have not been borrowed, like ours, from the external world; it has done better than that, proving itself thereby to be nearer than we to the springs of life; it has created those weapons out of its own body, evolved them from within itself by a kind of concrete materialization of its heroism, by a miracle of its imagination, of its will-power; or perhaps because of some secret alliance with the soul of this world, some knowledge of mysterious biological laws for which we still are groping."

And

"It is childish to speculate whither things, the worlds, are bound. They are bound nowhere; and they have arrived. In a thousand million centuries the situation will be the same as it is today, the same as it was a thousand million centuries ago, the same as it was since a beginning which does not exist, and as it will be at an end which also does not exist."

On the entomological side the author's tendency to refer to the more than a thousand species of termites as "it," often generalizing on the basis of limited instances, and the fact that his data concern chiefly conditions in the tropics may mislead readers who are interested in our northern species; for example, the chapter on "devastations." Only a specialist, not even a general entomologist, could be expected to write concerning such a complicated subject with any hope of escaping all misstatements of fact. Maeterlinck, a layman, did remarkably well and his essay was probably not intended to be an entomological monograph.

F. E. L.

Game in the Desert

- - - - - - - by Jack O'Connor

The Derrydale Press, New York, $15.00

Game in the Desert is a book written by a sportsman and for sportsmen. The author has had an extensive experience in our southwest and adjacent Mexico, he tells his story well and his publishers have built him a book that will make a fine appearance in any library.

The treatment of the book is systematic, taking up the principal game species of mammals and birds one at a time, outlining something of the life history of the subject, and brightening the text with stories of personal observation. Most lovers of outdoor life will find this book very interesting. A Museum review of the book would not be sincere, however, if it did not take issue with the underlying thesis of the author, who writes, page 268:

"And those who save the game will be in the future as in the past the intelligent, unsentimental, well-informed sportsmen of America, the men who can see that game is primarily a crop, romantic and interesting though it may be. It is a crop to be harvested by shotgun and rifle instead of scythe and mowing machine."

This is an honest, straightforward statement, whether the reader can subscribe to it or not, and because it happens to be the point of view of many sportsmen it needs to be given full consideration by nature lovers who believe that there are other factors besides "cropping," as O'Connor sees it. This reviewer has hunted on four continents and should have some appreciation of the desires of the sportsmen, but he has also studied the problems of conservation as posed by the non-shooting public and he has arrived at no such dogmatic solution as defined by this author.

The reviewer sees no violence done to conservation if there be a reasonable "cropping" of animals, and he might even concede judicious control of predatory species (if such a thing be humanly possible) but he does not conceive the ideal of conservation to be that state of affairs where the fitness of every animal to survive is judged by its attractiveness over a gun sight or, contrariwise, by its ability to kill first something that he might kill later. Many coyotes or many lions may become too many by any standard, but, also, elk or deer may become too numerous for available range and hence undesirable. There should be a happy medium, and recognition of this fact is just as much up to the "sportsman" as to the "sentimentalist."

H. E. A.

Problems of Ageing

- - - - - Edited by E. V. Cowdry

Williams and Wilkins Co., Baltimore, $10.00

Civilization progresses not only by overcoming the obstacles presented by nature, but in no less degree by solving the problems which it creates itself. Mankind took a long stride forward when it began dwelling in communities and cities, but it also created serious social problems which have at times threatened its very existence. In recent years we have become aware of the fact that our advances in medicine, combined with a rise in standards of living, have brought about a situation in which men live twice as long as they used to and individually produce a fraction of the number of children that their ancestors did. Such a combination of events has initiated a trend in our population which in another generation will result in one-third of the population being over fifty years of age. With so large a proportion of the population in full senescence or verging upon that state, it is obvious that a train of serious problems rooted in the phenomenon of ageing confronts the effective operation of our society. The ramifications extend into many branches of life, but one of the fundamental aspects of the problem of ageing is to be found in the psychosomatic field.

Aware of the immense social significance of this population trend, the Macy Foundation has wisely brought together a number of specialists in various branches of science, inviting from each of them a summary of the general problem of ageing as viewed by their special disciplines. These papers have been published in a single volume which it is hoped will stimulate further researches on this vital question.

The communications, twenty-six in number, including a pregnant introduction by John Dewey, represent as many fields, ranging from botany, invertebrates and entomology to specialized aspects of medicine. It would be beyond the scope of this review to attempt to assess each of these contributions, even if it were within my powers. To list the names of the contributors alone would be to array the leading men in each of their respective disciplines. It is perhaps enough to state that this volume serves as a milestone in the serious study of the phenomenon of senescence. No student of the psychosomatic phases of ageing in man can afford to omit it from his library.

H. L. Shapiro.

Eyes in the Night

- - - - - - - - by Tappan Gregory

Thomas Y. Crowell, N. Y., $3.50

The enjoyment and understanding of nature, after dark, will be stimulated and enriched through a careful reading of *Eyes in the Night*. There is a tremendous gap in our knowledge of the behavior of animals that become active long after the sun has set. Here is a world apart, the significance of which we grasp mainly through mysterious and inadequate rustlings along the trail, the occasional, indistinct cry of bird or mammal, or the sight of eyes gleaming all too briefly in the flashlight's unsatisfactory beam. The author of this book has progressed far beyond ordinary methods employed by naturalists who seek woodlore at night. His discoveries have become both articulate and visual to all who wish first hand, expert and colorful information.

Tappan Gregory is one of the world's outstanding wildlife photographers. In addition, he is a true student of mammals and a fine story-teller. This combination of talents has produced a valuable book designed as a guide to those who would hunt with the camera at night. The account does not issue from one whose hands are prematurely stained with dark room chemicals, or whose myoptic eyes are better

adapted to Kleig lights than to the inconstant glare of a beckoning sun. The author's camera lens, his *Eyes in the Night*, operate, as a rule, many hours after the focus has been set and all placed in readiness for the exposure. Wild animals, large and small, release the shutter of their own accord, often while the photographer enjoys a good night's sleep in his own bed far from the scene of activity.

The elusive shrew, shy mouse, wandering bear, light-footed deer and sly wolf have all taken their own portraits at Mr. Gregory's insistence. There is high adventure in this form of photography and we soon realize this fact. Perhaps the account of experiences with wolves is the most exciting. The black bear that blundered into the flashlight trap is presented engagingly, not to mention the prowling house cat that received the surprise of his life or the mountain lion that, for a moment, lost his dignity. We hope that Mr. Gregory may some day be induced to publish more of his photographs and relate added experiences.

WILLIAM H. CARR.

CONSERVATION IN THE UNITED STATES

by A. F. Gustafson, H. Ries, C. H. Guise and W. H. Hamilton, Jr.

Comstock Publishing Co., $3.00

THIS is both a vigorous and an informative book by four members of the Cornell University faculty who have set an example in effective collaboration. While necessarily dealing with familiar subjects, a large proportion of the items used to exemplify bad practice have a pleasing freshness. The illustrations have also been particularly well chosen to illuminate and reinforce the text, while the maps, graphs and block diagrams maintain a high standard of modern geographic exposition. Use of the book for teaching purposes is facilitated by a list of well-chosen questions at the end of each chapter. There is an excellent bibliography, selected from the point of view of supplementary reading, and an adequate index.

Following a useful historic introduction, the authors take up successively the conservation of soil and water resources, forests and grazing land, wild life and mineral products. The last section is one for which there has been particular need in a general work on conservation; too often in kindred books such non-renewable wealth as the rarer metals, natural gas, etc., are avoided altogether in favor of detailed treatment of topsoil, ground cover and animal life.

Another particularly welcome section of the book is Professor Hamilton's summary of the plight of American fisheries resources, a subject on which Ackerman has recently published figures that are nothing short of appalling. Like every competent work on the subject of conservation, the effect of this book upon a thoughtful reader is necessarily shocking, or even overwhelming. The present status of soil conditions alone only serves to reinforce the following statement made by J. N. Darling in 1937: "Thirty-five years from now we will have left just three acres of good tillable land per capita. That is the lowest possible minimum upon which Man can maintain a standard of living which we consider ours. After that we head downward toward the level of the Chinese."

R. C. M.

KOONWARRA

- - - - - - - -by Charles Barrett

Oxford University Press, $3.00

THIS book is an account of forty years of traveling in Australia. The author, a newspaper man by profession, but an amateur naturalist in his heart, has seen the north and the south, the east and the west of the fifth continent. There is little of Australian nature lore that remained hidden from him on trails and camps in the virgin forest of Queensland, the coral islands of the barrier reef, the eucalyptus forests of Victoria and the wastes of central Australia. Twice he crossed the entire continent penetrating from the luxurious belt of the coastal fringe to the very heart of the sandy desert. The volume is filled with reminiscences and anecdotes, in fact it is composed of them. "A rambling chronicle you will say. But have I not a rambler's freedom to go anywhere; to leave the highway and follow any track that lures?" This lack of continuity is rather distracting to the reader, at times even annoying when trivial incidents of the camping life or the author's opinions on dancing or drinking are sandwiched in between fascinating accounts of "birds and beasts." His sketches of the lives of the Duck-Bill *(Platypus)*, of the Giant Earthworm of Victoria, of the Black Swans (Koonwarra), of lizards and snakes, of ants and beetles are interesting and amusing. It is the best part of the book next to the 50 beautiful plates depicting Australian plants, animals and natives.

E. MAYR.

NATURAL HISTORY OF THE BIRDS OF EASTERN AND CENTRAL NORTH AMERICA

- - - - by Edward Howe Forbush. Edited by John Bichard May

Houghton Mifflin Co., $4.95

ONE of the most valuable and satisfactory sources of information on the habits of our birds is Forbush's *Birds of Massachusetts*. A life-long student of birds, familiar with the needs of bird-lovers, Forbush accumulated not only a mass of data in his field but he also acquired the faculty of instructing others. His bird biographies, therefore, are both full and accurate and they are so well arranged that the facts they contain are readily accessible.

If Forbush's deservedly popular work had been published by a commercial house it would have been republished as long as the demand for it continued—in other words, indefinitely. But it was issued by the State of Massachusetts and was therefore a product of changing conditions which are more concerned with the present than the past.

Since, therefore, the State did not propose to issue another edition of Forbush, it was an admirable plan for the Massachusetts Audubon Society to secure permission to prepare an abridged, one-volume edition of this book to be issued by a publisher at about one-third the cost of the original.

The preparation of the new work was very properly placed in the hands of John B. May, long associated with Forbush. To force the contents of three volumes into one, while including treatment of 100 additional species, calls for the exercise of rare editorial skill and discretion. The result certainly justified Doctor May's selection for this difficult task. The new book will not replace the old one, but it makes accessible the essence of the biographies which so distinguished the original.

It must not be forgotten that no small part of the value of Forbush is due to the excellence of its colored plates by Fuertes and Brooks. It is a pleasure to discover that in the May edition these plates have been adequately reprinted. Careless printing has denied Mr. Peterson's four plates the treatment they deserve. Doubtless this defect will be remedied in subsequent editions.

FRANK M. CHAPMAN.

BRITISH GUIANA PAPERS

Scientific results of the Oxford University Expedition to British Guiana in 1929

Oxford University Press, $7.00

THIS collection of one general, 20 botanical and 10 zoological reprints gives the scientific results of the Oxford University Expedition to British Guiana in 1929, which penetrated into the canopy of the tropical rain forest. The expedition was particularly concerned with habits, instincts, life histories, behavior, and problems relating to ecology. Many entomological results still remain to be worked out. These and other papers will be collected later on in a second volume.

A NATURALIST ON RONA

- - - - - - - - F. Fraser Darling

Oxford, at the Clarendon Press, $2.50

HERE is another islander, already familiar to readers of reviews in NATURAL HISTORY. He goes it alone, and his point of view is somewhat more ostensibly serious and self-conscious than that of Lockley. The key to the distinction is found in the subtitle of his volume, which is "Essays of a Biologist in Isolation," and by the formidable initials "D.Sc., Ph.D., F.R.S.E.," appended to the author's name on the title page.

As he himself states, "An island is more than a speck in the sea to a naturalist—it is usually a metropolis of the animal world and a busy port of call for a variety of migrants. The island naturalist is a gnome-like harbour-master and city chamberlain, setting everything down in his little book."

Darling tells an interesting tale of gray isolation close to the surge and thunder of

Continued on page 63

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LETTERS—*Continued from page 57*

Concerning the statements in "Man and Music" by Mary Huntington (NATURAL HISTORY, September, 1939) "there seems no doubt that dancing regularly accompanied music in the early Christian church. . . . A papal decree in 744 abolished dancing —in churches and cemeteries. . . . If memory serves rightly, church dancing was revived in a New York church several years ago," we receive the following letter:

SIRS:

The New York church to which you refer was St. Mark's-in-the-Bouwerie, the dance the "Ritual Dance of the Della Robbia Annunication," the first dance to be used in a church as worship since medieval tradition was broken.

However, it first took place in *1920* and was *not* soon abandoned. It became a local feast and was repeated every year on the Sunday nearest the Annunciation until 1937 when Dr. W. N. Guthrie, the initiator of the movement, retired from St. Mark's.

The sensation created by some of the papers and later apologized for, far from leading St. Mark's to abandon the enterprise, challenged them to continue with it, and the "Ritual Dance" became only one of fourteen or fifteen original productions undertaken by St. Mark's during those years.

New York City. PHOEBE GUTHRIE.

Because of repeated requests, a Bird Study Group to be conducted by Farida A. Wiley is being organized by the Department of Education. Emphasis will be placed on local birds. Mounted specimens, study skins, exhibits in Museum halls and two field trips will be among the aids used at the various study periods. A fee of $10 for the fourteen sessions will be charged, with a reduction in price for Museum members. First session, February 6th, at 3:30 p.m. Registrations may be made at any time by writing to the Museum or calling ENdicott 2-8500, Extension 342.

Other unsolicited comments recently received:

From a celebrated American author: "Having long since made up my mind about the 'mishap' in Europe, I now read no other magazine than yours."

From a British author: "Congratulations on NATURAL HISTORY. It is great stuff. There's no doubt about it, you Americans know how to turn out first-class magazines!"

From the Vice-President of a large transportation company: "NATURAL HISTORY Magazine is full of mentally exciting material."

- "A specialist in bone and joint surgery with dozens of hobbies, I read almost every article in NATURAL HISTORY with great satisfaction."
- "You may know we like it when I tell you I subscribe also for a minister's family and my nephew in Florida."
- "I find your magazine not only very interesting but beautiful. I am happy to take this opportunity to tell you I really enjoy your magazine tremendously."
- ". . . Excellent and educational."
- "I always look forward to receiving the magazine."
- "I hear many words of commendation from our club members relative to the truly beautiful magazine NATURAL HISTORY, which is upon our library table."
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NOTICE: Readers are encouraged to submit their own photographs of natural history subjects. Those selected for publication on this page will be paid for at $1.00 each, with full credit to the photographer. Return postage must be included.

THE TALL TRUTH

DRINKLESS ANIMALS

A man lost in the desert will seriously feel the lack of water after the first day, and death is apt to overtake him in considerably less than a week. The scorching sun and parching wind of the waterless desert are synonymous with torment. Water is a vital necessity for life, and all living forms contain a large percentage of water, usually considerably more than 75%. But in combatting the lack of it, man is ill-fitted to compete with certain animals, the most remarkable of which live most comfortably in the regions where man suffers worst.

The camel, although popular fancy gives him credit for exceptional ability, is by no means the champion. True, a laden camel may travel for three or four days without drinking, and an unburdened one might go a week or more. But there are limits to the camel's endurance, and when opportunity offers, he drinks quantities of water.

The rare dama gazelle, the addax and the scimitar Oryx of the Libya and Sahara Deserts, go for years without drinking, if indeed they ever drink. The water they require is secured from succulent plants found in the desert, and they apparently retain the precious moisture better than animals of the regions where water is abundant.

But the champion "Drys" of the animal kingdom are certain desert rodents. They never drink from birth to death, and feed chiefly on dry seeds. The necessary water is for the most part "manufactured" in the physiological breakdown of foods. In these rodents the excretory system and the intestines are modified to conserve bodily fluids to the utmost.

JOHN E. HILL.

YOUR NEW BOOKS

Continued from page 61

the western sea. The meaning of the elaborate displays by birds, the significance in the social life of animals of responses which escape all but the quickest and keenest of human eyes, intimate and rarely witnessed behavior in the home life of seals—such are the subjects that claim the patient attention of the author. His illustrations, as hardly needs telling, are among the finest examples of the wild-life photographer's art.

R. C. M.

INFORMATION TEST

A few informational high spots that may be gleaned from this month's NATURAL HISTORY

Score 5 points for each correct answer. Correct answers on page 64.

1. The mother porpoise, like other aquatic mammals, must retire to dry land to nurse her young.

True..... False.....

2. The jade carving of the "Reclining Lady," was used by the Chinese to
(a) Determine an ailment
(b) Overcome insomnia
(c) Pray for a life of leisure

3. Louisiana's late famous politician got his nickname of the "Kingfish" from the fact that the kingfisher is the State bird of Louisiana.

True..... False.....

4. A parent pelican will tear its own breast to feed its young.

True..... False.....

5. The porpoise never sleeps.

True..... False.....

6. Which of the following cannot be made without help of an insect
(a) Ink
(b) Shellac
(c) Lipstick

7. What makes scientists believe that the oldest known primitive man may have been murdered?

8. Taoism is
(a) A Chinese philosophical religion
(b) An extremist school in French painting
(c) A system from which Technocracy sprang

9. The porpoise is a
(a) Mammal
(b) Fish
(c) Reptile

10. Pelicans lose their vocal powers upon reaching maturity.

True..... False.....

11. The swastika symbol was recently added to Buddhist symbols because of Nazi influence in China.

True..... False.....

12. The Venus's-flytrap is
(a) A new type of sticky paper that traps flies
(b) A baited steel cage which flies can get into but not out of
(c) A plant

13. What have the following in common?
(a) Shellac
(b) Silk
(c) Honey

14. Camels were once native to America.

True..... False.....

15. A continuous thread unwound from a silkworm cocoon may be
(a) 1000 yards long
(b) 100 yards long
(c) 10 yards long

16. The Fortunate Islands are
(a) Part of the Hawaiian group
(b) Islands in the Baltic which are not being sought as air bases
(c) Imaginative heavens of the Chinese

17. The male cochineal insect never eats.

True..... False.....

18. No example of a type near the "missing link" in the evolution of man from ape has ever been found.

True..... False.....

19. Why does a porpoise whistle?

20. What is the Chinese equivalent to the "Man in the Moon?"

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THE MEMORIAL SUBLIME

Carillons

Skyward Again For Pictures

By CHARLES H. COLES

Chief Photographer, American Museum of Natural History

THE glittering stars of winter form such effective groupings in the sky that it is natural for anyone interested in photographing natural phenomena to want to try his hand at star pictures. The results obtained from such pictures are gratifying indeed.

As soon as we start to investigate stellar photography a new optical phenomenon pops up at once. Stars are so far away from us that they do not show any appreciable disk. They appear only as tiny points of light more closely approaching a theoretical point source than anything we know. They are also, for all practical purposes, infinitely far away. Now when we set our cameras for infinity, the lens should image a point of light at infinity as a point of light. The better the lens, the smaller should be the point.

In ordinary photography, when we want a larger image of an object, we either get closer or use a telephoto lens. We can't get closer to the stars and a telephoto will still make only point images. Therefore we can say that the focal length of the lens has no effect on a star's image. This being the case, our normal definition of lens speed won't work. Usually we say that the speed of a lens is calculated by dividing the focal length by the diameter, this division resulting in the "f" value of the lens. Thus a lens of three and one-half-inch focal length and one-inch diameter has an effective speed of f/3.5. But because the focal length has no effect on the size of a star's image, the speed of a lens when used for astro-photography is determined solely by the aperture of the lens regardless of focal length. Thus any one-inch diameter lens, whatever the focal length, will be as fast as any other of the same diameter. We are assuming that the internal construction of the lenses is similar so that the losses by reflection and absorption are about the same.

Whenever a description of an astrographic camera is given, therefore, the diameter of the lens is the only indication of lens speed that is needed. Thus if you have a camera with an f/2 lens of two-inch-focal length you won't get any more star images in fifteen minutes' exposure with a fast film than your friend with an f/4.5 lens of four-and-a-half-inch length using the same kind of film, because both lenses have a diameter of one inch.

Making the star pictures

When a clear night comes along and the stars are bright, fasten the camera to a tripod and set it for infinity while you are still indoors. Adjust the shutter for time exposure, open the lens wide, and then go out into the cold. Set the camera up in a place where no lights will shine into the lens and wind will not vibrate the tripod. Aim at some conspicuous star group and open the shutter. With a one-inch lens, an exposure of five minutes will be ample to record the brighter stars on fast film. After the exposure, close the shutter but don't bring the camera into the warm house directly or the lens will fog over. Allow it to warm up slowly. Moisture may deposit in the shutter and rust the tiny bearings if this precaution is not followed.

After the picture has been developed, set the negative down on a piece of white paper and look closely for the short star trails. While the exposure was in progress, the earth was moving the camera slowly so that the stars recorded as short streaks. Any spots that are not streaked should be looked upon with suspicion. They are probably dust specks.

Now for some retouching! With a fountain pen, place a dot of ink on the right-hand end of each streak, making the size of the dot proportional to the thickness of the star trail; a heavy dot on the heavier trails and a light one on the finer lines. If you have done your work carefully, you will find that you have reconstructed the star group at which you pointed the camera. Make a print now of your constellation chart.

Types of pictures

If exposures of fifteen minutes to several hours are made, the direction in which the camera was pointed will affect the type of trails that are recorded. Pointing the camera toward the North Star will produce trails that circle about the pole. A six-hour exposure will result in the star trails becoming quarter circles because the earth, and therefore, the stars, makes a complete revolution once in about 24 hours.

A camera directed toward the celestial equator will record straight star trails. An easy way of finding the equator in winter is to locate the brilliant constellation of Orion, which is about half above the equator and half below.

If you are lucky, a shooting star will fall through your camera's field of view while the exposure is in progress. If it is a bright one, by all means note the time of fall and the date and send the picture to an observatory. It may constitute a valuable record. Sometimes streaks appear on star pictures from an unknown cause. If close examination shows that such a streak is not uniform in intensity and quite straight, the chances are it was a meteor.

Try your hand at star pictures. They will be records that you will return to time and again with a glow of pleasure.

If you want to know more about celestial photography, the latest information about this science is given in the section on "Astronomical Photography in the new *Handbook of Photography*" (Whittlesey House, McGraw-Hill Book Company, $7.50). As a matter of fact, this new book gives the most complete and up-to-date information on the whole field of photography that is available. Twenty-three experts in various technical branches of photography describe in detail the essence of their experience. Photography is approached in this book for the first time as a science, not as a kind of black magic. This volume is a valuable reference work for anyone seriously interested in scientific photography.

Recent Museum Publications

NOVITATES

No. 1047. The Riddle of *Oxyruncus*. By Frank M. Chapman.

1048. A New Bandicoot from Iran. By G. G. Goodwin.

1049. The Brachyura of the Second Templeton Crocker-American Museum Expedition to the Pacific Ocean. By Melbourne Ward.

1050. Five New Rodents from the Eastern Elburz Mountains and a New Race of Hare from Teheran. By George G. Goodwin.

1051. The Upper Zonal Birds of Mt. Auyan-Tepui, Venezuela. By Frank M. Chapman.

BULLETIN

Volume LXXVI Art. vii. A Revision of the Typical Crab-Spiders (Misumeninae) of America North of Mexico. By W. J. Gertsch.

NOTE: Detailed lists of Earlier Publications of the Museum on the following subjects are available on request from the Library: Anthropology; Vertebrate Palæontology; Mammalogy; Arthropoda; Ichthyology; Ornithology; Reptiles and Amphibia; Invertebrates except Arthropoda; Invertebrate Palæontology, Geology, Mineralogy and Palæobotany.

Answers to Questions on page 63

1. False. See page 18
2. (a) Determine an ailment. See page 13
3. False. The State bird of Louisiana is the brown pelican. See page 46
4. False. See page 46
5. False. See page 21
6. (b) Shellac. See page 44
7. The fact that the skull of Java Man showed a break which might have been caused by a stone implement. See page 34
8. (a) A Chinese philosophical religion. See page 7
9. (a) Mammal. See page 17
10. True. See page 46
11. False. The swastika is one of the Buddhist symbols in use for centuries in China. See page 8
12. (c) A plant. See page 30
13. The fact that they are all manufactured by insects. See pages 44-45
14. True. See page 43
15. (a) 1000 yards long. See page 44
16. (c) Imaginative heavens of the Chinese. See page 7
17. True. See page 45
18. False. See page 36
19. To express excitement or fear. See page 19
20. The three-legged toad. See page 11

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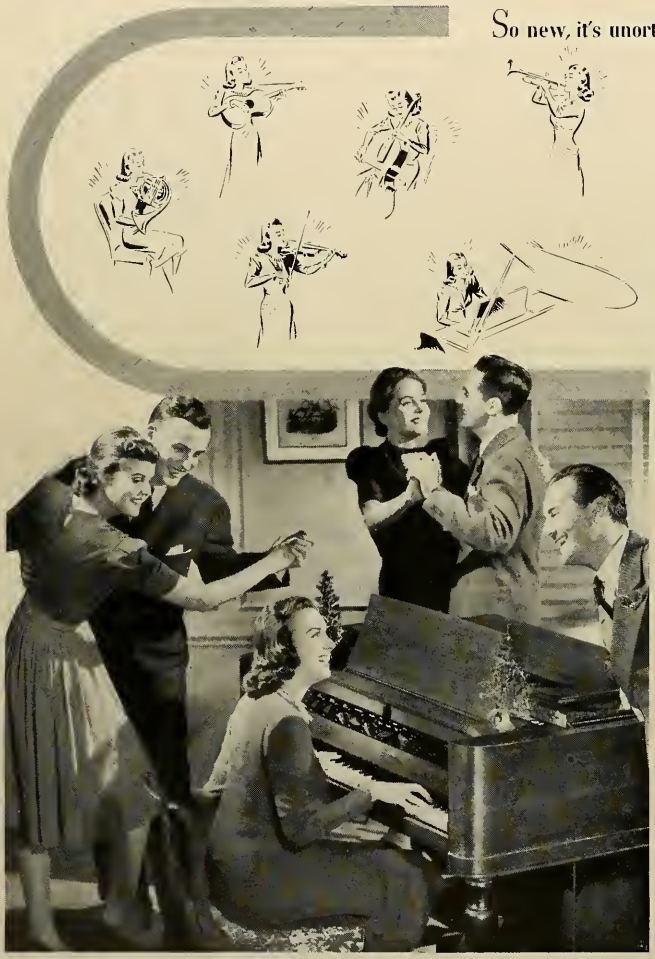

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Above illustration from Bird Group of Hudson Bay Region in the American Museum of Natural History

INFRA-RED PHOTOGRAPHY

A way to dramatize the scenic outdoors

By John N. Harman, Jr.

THE serious nature photographer who has not yet used infra-red film has a pleasant surprise in store for him, for with this particular type of photographic material, an unusual sort of tone recording is obtained in the final photograph which lends an aura of fantasy and unreality to many pictures and permits a dramatic treatment of outdoor scenery that might when photographed on conventional films, look commonplace and dull.

Consider, if you will, the efforts of the more advanced amateur to capture the difference in tone between blue skies and banks of white clouds by use of panchromatic film and yellow filter. By such technique, the amateur succeeds in recording the blue sky in tones of gray so that white clouds are brought more prominently into relief. When infra-red film is employed along with a filter that excludes any visible rays to which the film is sensitive, this effect is carried to the extreme, and a novel and ofttimes surprisingly beautiful recording of white cloud formations against a very dark sky is obtained. This is but one of the interesting applications of infra-red film for the photographer who delights in taking photographs of scenery and outdoor views, but it illustrates the unusual way in which the film behaves.

For one using infra-red film for the first time, the essential difference is one of color sensitivity, for with infra-red film an added range of sensitivity is available, making it possible to take photographs by radiations found at and beyond the red end of the visible spectrum. In the case of panchromatic films, the range of sensitivity is roughly equal to that of the human eye. Thus the tone recording provided by a balanced panchromatic film results in photographs that have a normal relationship of tones. However, with infra-red film, registration of the image is accomplished solely by a limited band of radiations which pass the filter and affect the film, and which are, to most persons, almost entirely invisible; it is perhaps not surprising, therefore, that unusual tone relationships result in the finished photograph. The practical result of this particular type of color sensitivity is the registration of blue skies, water and other blues and dark greens as total black or in very dark tones of gray; of clouds, snow, sand and white objects in varying tints of creamy white; of green leaves and foliage containing chlorophyl (which reflects infra-red radiations) in varying tones of light gray; and of other colored objects in various tones of gray, depending on the amount of infra-red radiation reflected by each object.

Convincing proof of the ability of infra-red film to "see" objects the human eye cannot is furnished by photographing objects heated just below a dull but visible red heat. A common electric iron, for example, can be photographed successfully in a completely darkened room if the camera, which has been directed at and focused on the hot iron, is loaded with infra-red film.

Photos by C. H. Coles

Winter and spring *simultaneously through the magic of infra-red film. Above: infra-red film, 1/15 sec., f 5.6, Wratten A filter. Below: panchromatic film, 1/50 sec., f/11, Wratten K2 filter*

The required exposure is moderately long, depending on the lens aperture and also upon the particular type and extent of infra-red sensitivity possessed by the film, but under proper conditions a photograph may readily be obtained with these invisible rays.

The amateur photographer desiring to take infra-red photographs for the first time can start most advantageously with any 35 mm. miniature camera having an f/3.5 lens.* With such equipment and with a filter that is deep yellow, orange or red to absorb blue light to which the infra-red film is also sensitive, instantaneous exposures may be made in bright sunlight. While many photographers prefer a dark red filter for most pronounced effects, any totally blue-absorbing filter is satisfactory with most infra-red films, as they are sensitive only to ultra-violet, blue and blue-green, and to the infra-red radiations. With such a filter, the basic recommendation of 1/25 second at f/3.5 for outdoor subjects in bright sunlight may be safely used with the assurance of obtaining satisfactory results. It is not necessary and is, in fact, not advisable to employ the popular type of photo-electric exposure meter to indicate the proper exposure, inasmuch as these meters are, like the human eye, relatively

Continued on page 126

* In addition to miniature camera size, infra-red film is manufactured in cut sheet film in all sizes and in common roll film form if ordered in quantity.— Ed.

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NATURAL HISTORY

The Magazine of the American Museum of Natural History

FREDERICK TRUBEE DAVISON, President — ROY CHAPMAN ANDREWS, SC.D., Director

VOLUME XLV—No. 2 ★ ★ ★ ★ ★ ★ FEBRUARY, 1940

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More awe-inspiring *than the cliff that meets the sea was the cliff beneath the sea that dropped to unknown depths—more mysterious and more terrifying*

THE EDGE OF THE EDGE OF THE WORLD—

An undersea adventure in the tropics on the edge of a submerged cliff 7000 feet high

By GILBERT C. KLINGEL

HELMETED and visored like some knight of old, I stood motionless in my diving helmet on a great mound of yellow rock 40 feet beneath the surface of the ocean nearly a half mile from the shore of the tropical island of Inagua in the Bahamas. Slowly I crouched, stooped nearly to a sitting position, and then sprang into space. Up I soared, five feet, ten, fifteen, on up to twenty slowly drifted to a stop like the lightest feather and then gently coasted down again. I landed on a smooth stretch of sand, bounced a tiny bit and, like an actor in a slow motion picture, came to rest. Breathing a sigh of relief I turned and looked at the jagged rocks I had just cleared with my amazing leap.

A scientist's curiosity

I was glad I had not misjudged the distance, as an error would have resulted in badly scarred limbs. Strange, I thought to myself, the chances a man will take for the sake of curiosity. There was no other excuse I could think of for my being there in a diving helmet among a wilderness of towering rocks and crags that sloped jaggedly towards the center of the ocean. True, I had come to this forgotten little island ostensibly to engage in biological research for a scientific society, but this present escapade had little to do with science. For weeks I had stood on shore and looked at the place where the color of the ocean changed abruptly from light green to dark blue, marking a sheer drop of 1200 fathoms, a terrifying plunge to the uttermost depths. Finally I could resist the temptation no longer; I had to see what the edge of that submarine cliff was like.

With the aid of a native sailboat captain I loaded my diving helmet into the boat and anchored just a few feet on the land side of the brink. In a few seconds I was on the bottom. I looked about. Behind me trailed a long line of snaky black hose that curled up toward the sky. Up it went until at 40 feet it faded into a blurry twisting line. At its base and from beneath my helmet gurgled great silvery clouds of bubbles, iridescent globules that hurtled upwards until they, too, disappeared into the haze. In each bubble I could see my reflection, an odd gargoylish image showing a distorted creature clad in glass and bronze.

At my feet were distorted masses of jagged, moss-covered rocks, deep crevasses, and shadowy holes. It was to clear one of these crevasses that I had taken my spectacular leap. Twenty feet is a tremendous jump, but although I was carrying nearly 80 pounds of lead, I was so light in the water that with a slight push of my toes I could glide about like a feather.

I peered about, trying to get some hint of direction. Above and to all sides there existed nothing but blue water, a filmy evanescent blue that baffled description. Leaning far backwards, I looked towards the surface. Still nothing but liquid blue, perhaps a trace lighter than the color to each side. There was no such thing as direction. North, east, south, and west were all the same. Blue water everywhere; one was drowned in it, lost in azure.

Only the sand at my feet, heaped in little piles between the rocks, helped to stabilize, to give a hint where I might find the edge of the cliff. I knew that it was close because my naked flesh could detect a faint cold current coming up from the depths. Hesitating, I turned my body this way and that, trying to catch the direction of the current. But it was too slight, too vague to help. Then my feet gave me the clue. The bottom was uneven, very regularly uneven. I looked at the piles of sand. They were heaped in hundreds of little windrows, long waving lines that faded away into the blue immensity. They reminded me of the miniature waves we see in the sand on the seashore when the tide is out. I guessed that they would run at right angles to the shore opposite the direction of the tide. My course was parallel with them.

Chill of the deep

On I pressed, leaning hard against the water. Presently the cold became more pronounced, a gentle sort of chill that merely gave a hint of what lay before, like the faint coolness that sometimes comes on dry land in September before the leaves are gone.

A feeling of loneliness swept briefly over me. I felt as though I were the only person in the world, as indeed I was, at least in that portion of the world; for though I knew that only 70 feet away the sailboat captain was steadily stroking the pump that kept me

alive, he might well have been on Mars, so separated were we by the thin film we call the top of the ocean. And I knew that I was treading a spot where no man had ever trod before, that my eyes would be the first to see this huge underwater cliff that dropped away for nearly 7000 feet before it reached the floor of the ocean. Perhaps it was the deathly stillness that gave the feeling, for no sound came to my ears but the faint hiss of the air that came down the hose.

Nervously I tightened my grip on the life line, a thin rope that customarily trailed loosely through my fingers. The sailboat captain had warned me of huge sharks and barracuda that lived on the edge of the cliff, but I had scoffed at him and told him that I did not believe that sharks would attack a normally behaving diver. Now that I was by myself and lost in an azure immensity, I was not so sure.

The edge came sooner than I expected. Suddenly I was peering down into a great blue void. The soil had disappeared at my feet and the bottom had become soft and yielding. For an awful second I could feel the sand drifting, sliding downwards and frantically I seized the life line and grasped it tight. I knew well enough that I would not drift ten feet before I would be checked by hose and line, but the space below looked so utterly vacant that I could not help reacting as I did.

Trembling just a little, I sat down on the soft bank and peered downwards. It was an overwhelmingly empty space. Down, down into the terrifying out-of-focus blur the sand sloped away. There was nothing down there but deepness, empty, dark, and cold.

Like an invisible wall a chill feeling hung on the edge of the cliff. I stirred one of my feet. A little pile of sand drifted loose, gathered volume, and in a creeping slithering landslide, oozed its way down the slope. A faint cloud of powdery silt arose, gently spread apart, and slowly disappeared. There was something so serpentine, so creeping about that landslide. None of the rush and tumble of a slide on land—only a slow gentle falling into the depths. I imagined how horrible it must be to slide helplessly to death, should one lose hose and line, to drift oozily down, inch by inch, foot by foot, with the pressure increasing in a crushing, horrible grip. And I could imagine the creeping darkness that would come before unconsciousness would make it complete, a gradual deepening of color,

THE BOTTOM, *covered with vegetation, sloped jaggedly away towards the center of the ocean. In mid-water hang a school of blue tang, flat fishes of iridescent blue. Parrot fish and others graze on these underwater plants as more familiar animals crop sunny fields above*

ultramarine, azure, deep azure, blue black—and then utter darkness.

Clickety-click clickety-click—the faint sound of the air pump brought me back to reality. I reasoned that I was perfectly safe, and curiosity began to replace the sensations of panic. I wondered what lay below and what held the soft edge so evenly in place. I looked back. In a long even plain the sand and rocks sloped gently towards the surface, a rise that was so gradual as to be almost imperceptible.

I reached down and picked up some of the sand, tightly clenching it to keep it from oozing from between my fingers. Holding it close to the helmet, I examined it carefully. It was foraminiferous sand, not the hard quartz sand of American beaches, but sand formed from the dead and decayed shells of numberless sea creatures. In numberless billions these creatures had died, dropping their calcified remains in a slow organic rain to the sea floor. The cliff was a vast funeral pile of a million, million creatures. The ocean currents welling up from the depths had gathered it all there in one spot to make the edge of a world.

A shadow passed across the helmet. The shadow of the boat, I thought, and let the sand run between my fingers. Then a chill feeling ran up my spine producing a queer sensation at the base of my scalp. The boat was fully 70 feet back from the edge. It could cast no shadow!

I saw a darkened patch move slowly over the sand, slide over the rounded edge, and become nothingness with the gloom beyond. I looked up and nearly yelled into the recesses of the helmet. There, not fifteen feet above my head, was a great manta, the most gigantic of all the devilfish. It was flying—there is no other word for it—flying along in mid-water like some great bat or monstrous pterodactyl, looking like a vision of the forgotten past. Flapping its great expanded wings, it seemed to be soaring rather than swimming through the water.

I froze to the sand. The monster turned slightly, coming dangerously close to the air line, swooped gracefully over the edge, and faded into the depths. It must have measured fifteen feet from wing tip to wing tip.

I turned to grasp the life line to go to the surface and then froze again. The fish was returning. To the right I saw its huge bulk heading up out of the

BEYOND, *the bottom dropped away for 2000 fathoms—down to the depths of everlasting night: an isolated coral on the outer edge of the bank. The author descended over the edge of the deep as far as his life line would permit. The reef is off Inagua, in the Bahamas*

shadows. Up to the very brink it came, curled one great fin high, and in a sweeping curve turned up the edge of the bank. It headed straight for me and I could see its curved cephalic fins, looking like great horns, held straight downwards. Apparently they were being used for rudders, but the thought flashed into my mind that they were also used for sweeping prey into the mouth with its crushing rows of cobblestone teeth.

On it came straight for the helmet. There was nothing I could do. I was helpless, not even carrying a sheath knife. In a moment it was but fifteen feet away, then ten, and then, just as I was prepared to be crushed under its great spreading black and white wings, it banked sharply, swung eerily over my head, narrowly missing the air hose again, and disappeared to the left. As it banked I could see its little pig-like eyes glinting at me, jet black pupils set in a white iris.

I rolled over and caught a glimpse of the creature flying slowly towards the place where the boat was anchored. Behind it for three feet trailed a slim, rigid, black tail held stiffly like a rod. On its belly were two remora, slim gray and black fish with sucker pads on their heads. These pads are used much as we use the rubber suction disks on our automobile windshields and serve to attach the remoras to their host. As I watched, the remora slithered all over the creature's belly, riding without effort, waiting for the crumbs that sooner or later would scatter from the monster's feasting.

The devilfish swung again and then came back, but not so close this time. It passed within fifteen feet, steered wide of the air line, much to my relief, and turned down the edge of the bank. Rapidly it faded into the haze, became more and more faint, and finally disappeared altogether. I waited to make certain that it was gone and then went hand over hand up the life line as hard as I could go. In a moment I was safe and sound, panting in the sunshine on the deck of the sailboat.

"I tol' yo not to gwine down dere," the sailboat captain reminded me.

In later dives I saw this devilfish a number of times; its favorite occupation seemed to be cruising back and forth along the edge of the bank, and at no time did it attempt to molest me. I am convinced now that it was merely curious—like myself—and wanted to see what sort of strange hobgoblin I was. However, if it had sheared off my air line, its visit might have been tragic.

Half an hour later, after catching my breath, I went down again. I found the edge rather easily this time, but in a different spot. Here a patch of sea grass extended out to the very brim, and the sand was more firm. I made myself as comfortable as possible and sat patiently, squirting little jets of water on the glass to clear the mist that was forming from my breath. At first I saw nothing, but presently I made a discovery.

Silvery bodies

The edge was the highroad for hundreds of fish passing up and down the bank. The first that I saw was a large school of mackerel of a species that I could not determine. They were all about eighteen inches in length and were traveling about ten feet above my head. The glow of the sunshine filtering down through the blue caught their silvery bodies and highlighted each one with a gleaming line of yellow. I have never seen anything on dry land as brilliant except possibly the wings of certain butterflies. When I first glimpsed them, they were swimming leisurely; but suddenly, as one fish, they all broke into action. In a great yellow streaking line they darted toward the surface where some slim smaller fish were idling.

The smaller fish saw them coming and like living arrows they, too, streaked surface-wards. Looking up, I could faintly make out the opaque surface film and, as I watched, the smaller fish burst through and disappeared. Then I knew them for flying fish. Disappointed, the mackerel turned aside and resumed their march up the bank edge. I did not see the flying fish drop in again, as the haze and the distance obscured them from view.

Poison tentacles

Suddenly, my arm began burning as though on fire. Frightened, I whipped around, sending a white cloud of sand tumbling over the earth brim. Trailing over my arm were two or three strands of gelatinous tentacles from a Portuguese man-of-war, a lavender-colored jellyfish that was drifting over my head. Frantically I ducked the remaining tentacles and managed to elude them by throwing myself on the sand. The swirl of my action twisted the soft-bodied animal around, throwing the trailing stingers out of their graceful arrangement. I gasped, rubbed my arm, and was interested to observe that the man-of-war suddenly retracted its tentacles, drawing them well up under its partially deflated float. The expanded tentacles were fully ten or twelve feet long and, had I received the full benefit of their discharge, I would have had an exceedingly nasty arm. As it was, my arm burned and smarted for nearly two hours.

But the most interesting sight, after I recovered my equilibrium, was the host of tiny fish that centered about the jelly. I identified them as butterfish, the young of the same creatures that grace our tables. They have become associated with the Portuguese man-of-war and with other jellyfish, to which they

look for protection. When menaced by larger and hungrier fish, these butterfish slip quickly beneath the poisonous tentacles and take up a position safe from harm. Once in a great while, in the excitement of fleeing from an enemy, a butterfish blunders into a tentacle and is immediately paralyzed. Then the jellyfish has its innings and slowly, inexorably the tentacles contract and pass the helpless fish to the mouth to be devoured.

I was glad when the man-of-war was gone, for while they are very lovely in their delicate lavender colors, there is something very sinister about them, and they can sting frightfully. There is no group of creatures that so entirely fits into this strange world of underwater. Filmy, delicate, fantastic in shape and form, nearly 98% water themselves, unbelievably fragile, they melt perfectly into the underwater landscape.

Relieved, I sat down again and watched some margate fish come filing out of the haze. Unlike the mackerel, they traveled in twos and threes. They seemed to find little tidbits in the sand below the rim and their progress was rather leisurely, interrupted by all sorts of side excursions.

Once I saw a barracuda. Long and slim and graceful, it emerged from the filmy distance and came to a stop a few feet away. Across its gill flap was a deep line which gave it a hard, grim appearance. It eyed me coldly, hung motionless in the water for about three minutes, and then without visible effort slid away into the haze. I was not as nervous over the barracuda as I had been over the devilfish, though I should have been, for the barracuda are the reputed tigers of the sea. Many of the reported cases of shark attack are really to be attributed to barracuda.

Traveling turtle

The greatest thrill came when a great green turtle, weighing 100 ponds or more, swept by. It came from behind me somewhere, sliding just above the sand, reaching out with graceful motions of its flippers. It paid me not the slightest attention and went by within ten feet. Great masses of whitish barnacles covered its shell, and it was adorned with a filmy carpet of greenish moss. Like the manta, it was carrying a parasite, a remora attached to the underside of its shell. Hanging close to the bottom, it slid over the edge and vanished in the gloom. I could not help wondering where it was going, because I knew there was a limit to the time it could stay below. Turtles breathe atmospheric air and must come to the surface at regular intervals. But down it went, down into the hazy distance and the dark.

The turtle gave a clue to another type of migration on the cliff's edge, a migration that was not as important as the longshore migration. Fish were gliding back and forth from the depths and the shallows of the bank. The most abundant of these were the squirrelfish, queer reddish fellows with big dark eyes like those of some over-painted Spanish dancer. A steady stream of them filtered out of the depths. They seemed to know where they were going and headed straight for the rocks on shore. Others were returning, coming to the edge and slipping over and down. They were accompanied at times by red and blue parrot fish, brilliant creatures with protruding teeth. These also lived among the rocks, and I presumed they divided their time between the rocks near shore and some shadowy crags far below.

My last view of this edge of a world was one of the most awe-inspiring sights I have ever seen. I determined to go down as far as I dared and the pressure would permit. After a short rest I crept out to the very edge of the rim and, grasping the life line, let myself over. The sand started sliding beneath my feet, but I held fast and crept downwards. The slope was quite steep, but with the steadying line I managed to keep upright. Down I went, slowly, blowing hard through my nose to relieve the pressure on my eardrums. Down ten feet, fifteen, twenty.

I looked up. There was no hint of the surface. I was down 55 feet. Not much as modern diving goes, but a lot for the light equipment I was using. I knew that I should go no farther. But something drew me down. Curiosity again, that indefinable urge to see what is around the corner, to go a few feet more and a few more. I was beginning to feel the pressure. A heavy weight seemed to be pressing against my stomach and chest, and I was breathing heavily. Sixty feet. My head began to swim. Sixty-five.

A black pit

I hurriedly looked about. Down as far as I could see there was nothing but sand sloping away into infinity, sand and utter darkness, the most mysterious, quiet darkness I have ever beheld. There was something terrifying about it—it was so vague, so intangible. I turned back and struggled up the slope. High above, over the rim poured a halo of golden light. My head was reeling from the unaccustomed pressure. Hand over hand I pulled myself up the line. Even as I reached the rim a shining horde of golden motes poured over the edge. It was a great school of fishes going to the depths. We passed midway, for them the darkness and the cool—for me the glorious, dry, air-breathing world of the sun.

THE TIGER OF JAVA HEAD

By William Lord Smith
Staff Assistant, Education, American Museum

An adventure from the region made famous by Conrad and Kipling: his capture was planned in a lonely hut in the steaming tropical wilderness—an animal larger than those of the mainland, they said, and fiercer

I was out in Asia hunting tigers because I had been feeling socially out of gear and wanted to see what it would do for me to go around the world and hunt the most dangerous animal I could think of.

I had the good luck to track a Korean tiger—or tigress, to be exact—on a snow-covered hillside, and after an exciting stalk got within 40 feet before shooting her. Then I got a man-eating rock tiger who'd been pestering a village in from Amoy. I followed him in and out of the rocks while the Chinese villagers turned out en masse to jeer at the whole thing.

Victims

In this animal's cave we later found three human skeletons; and it was when I got this tiger that one of the boys shook my hand and said, "When man catchee wifee, he no more hunt tiger so-fashion."

And then I learned from reliable sources in Batavia that one of the most dangerous places in the world to study and shoot tigers was on the western peninsula of Java between Labuan and Java Head. It seemed these island tigers were not afraid of man. I knew that the tigers of Java and Bali, the most southern ones in the world, were supposed to be fierce of temper. I felt eager to meet one of them.

And it would be a good chance to prove what an English friend of mine, Harry W. Seaton Karr, had remarked while discussing animals of Africa where we were hunting at the time.

"It is good," he had said, "to hunt dangerous animals because you are more apt to get a shot. A dangerous animal is not always running away."

I wanted to know all about these Javanese tigers, their life history, methods of hunting, kind of country, whether or not they were good fighters. I was curious to see if an island tiger really is more dangerous than those of the mainland.

I learned that the peninsula was pretty much covered with jungle, large trees and brush, and cut up with grassy swamps and small rivers where there were plenty of crocodiles. There were wild banteng cattle there, huge black bulls, and muntjac deer; leopards, too; monkeys in the treetops and all the tigers you could wish for. One lived on the wild cattle, on excellent salad from the hearts of small palm trees, a stray peacock, jungle fowl and rice. What more could one ask?

Moreover, there were a Captain Sem, a Norwegian, and his brother trying dry rice farming down below Labuan, somewhere back from the coast. According to information through friends in Batavia, they would be glad to put me up during my stay. It looked altogether like a rare opportunity. I decided to take it.

A week in Batavia, and then I was going by rail to Burtensorg, traveling from there by pony chaise, down-country to Labuan. Along the roadsides the thick forest was interspersed with tiny banana clearings, which gave the landscape a peculiar charm. Delightfully small houses of bamboo guarded each of these plantations. As we trotted by, wayfarers all sat down and bowed their heads, a form of Malay courtesy.

Under sail in the South Seas

Labuan proved to be a tidy bunch of houses made of wood covered with white plaster. A fat Dutchman, the mayor, his fatter Malay wife and a swarm of brown babies lived in a more pretentious place. Everyone was friendly and helped me on my way. I hired a good solid Chinese junk with Malay crew and started coasting along the shore to look for my happy hunting ground.

It was my first adventure in the South Seas, my first adventure in the jungle; and I relished it no end.

I was told I would eventually come to a small river, the Tchilintang, where I should land and look about for a path which would lead me to the Norwegian Paddy Ranch. It sounded a little indefinite and so all the more fun. It was not to be forgotten I was sailing on the Sunda Straits, made memorable by Kipling and Conrad. In a way, it was my first command.

Our boat was light, for we carried nothing but food, so I was the cargo as well as the captain. We skimmed the choppy seas with Old Krakatoa pushing its smoking peak out of the sea on the right. No other craft was in sight; only the Java Head lighthouse lay off in the dim distance on our left. Once I could not resist putting in at a tempting little island. Perhaps nobody had ever landed on this morsel of land before! I felt like a monarch of the small coral principality, and brought away from it a collection of beautiful tropical shells.

On we sailed again in our little schooner for the line of jungle belting the coast. Every breath was an adventure. It was our summertime and the northwest monsoon filled the sails and our lungs, too, with fresh air as it swept down the Straits. The water curled under our bow as we headed for the swaying tops of the jungle. As we approached, we saw the tall figure of a man striding along the low-lying pebbled beach, and our boat leaped for the mouth of the river we were looking for, the Tchilintang.

I went quickly ashore to shake hands with the younger of the two Norwegian brothers, who had been advised by a letter and had rather expected I would be sailing down their way one of these days. He guided me through the forest by a much used trail with the trees lapping thickly overhead, and in a short time we came with unexpected suddenness to a big clearing where we could look up and see the blue sky again.

Jungle cabin

"This is our home," the Norwegian told me. I was particularly pleased at every sign that there were tigers around the place: every precaution had been taken to guard against them. Apparently they well deserved their reputation of man-hunters. The compound, which was perhaps a hundred yards square, had been fenced with stout logs to the height of six feet to keep tigers out. To be sure, there was a small open gateway which led into the compound, but a tiger would scarcely enter it for fear of a trap. The tiger is a suspicious and skeptical animal; anything he does not understand he is sure to take for a trap.

A path led us from the gateway to a wonderful log cabin in the middle of the clearing. There Captain Sem greeted me in a most kindly fashion. He was tall like his brother and wore a skullcap, an old coat and Malay sarong. Below were bare legs and feet. Both men were saving their only shoes, a dangerous habit in such a snaky country. They were delighted to see somebody from outside and get news of what was going on in the world. My message had told them that I was joining them to hunt tigers, and they were glad to have me do so. Then, too, I had brought along such foods as would vary the monotony of *dang dang* (wild cattle meat) and rice.

The whole cabin was a rice bin except for an open space in front on the ground floor, where we whiled away many a good evening hour in talk about our travels and hunting in various parts of the world.

A living from the jungle

A few months before, the brothers had lost their positions in a shipping office in Labuan, where the captain had been an expert pilot with good pay. Reduced to nothing, they had had to scrabble for existence. They thought, why not dig it out of the jungle?

The two of them had cleared the land of trees and stubs, built their cabin and gone in for dry rice farming. Their first harvest had brought them in plenty of rice. They could live, then. The wild cattle and young palms gave them meat and greens. A clear stream ran outside the fence, where later I took my midday bath under the trees, always with my rifle as companion.

It was altogether the kind of outfit Norwegian pioneers would rig up. To keep off sun and rain, the big cabin had been covered with rice straw. Upstairs were three little bedrooms fenced off by matting and mosquito nets. A long ladder helped us up to our beds on the second floor; no sensible tiger would try that ladder.

The Malay boys lived in another cabin close at hand. There was only one tree left in the clearing—a palm. This grew close to our cabin, yet strangely enough a wild peacock roosted in the tree every night and told us of his coming by his raucous "pau."

Life was lonely but not as bad as Crusoe's. They had the necessities. And some long steamer chairs brought in from outside gave us comfortable lounges in the evenings as we yarned about everything under the sun. We had plenty to talk over, especially when I told them I had been in Norway a couple of times salmon fishing, rype shooting and elk hunting. But more important than anything else, we could discuss the tiger situation in the neighborhood.

The tigers were never far from our thoughts. Their pugs—footprints—had been seen around the compound. The evening call of the tiger was heard across the *alang alang* swamp east of us. Natives who fol-

lowed the forest trails after certain birds' nests for which the Chinese pay a good price, had frequently lost a man or two out of their party. The tiger's method was invariably to seize the last straggler in the group.

We could have no doubt that the marauders were about. There was an abundance of the kind of game they liked: plenty of wild pig, their chief food, several kinds of deer, and monkeys which they could rout out of the treetops by growling. Scared to death by a growl, the monkeys would miss their jump and fall to the ground.

The "policeman's" footprints

Our native boys—except for Moda, my hunter—never spoke of tigers. They feared the tigers would hear of it in some way and kill them or their families. The nearest they came to mentioning their enemy was to say they had seen the footprints of the policeman who had passed the compound the night before.

Moda and I became very good friends. He came to believe in my rifle, though I never knew exactly how much he thought I had to do with the shooting. Before sunrise every morning we two left the cabin after a quick breakfast, to walk through the dried-up paddy field in the clearing, climb over the high fence and plunge into the semi-darkness of the jungle.

I never got over the feeling that I was in a huge cage. Underfoot we trod on trailing roots of the big trees, whose upper branches made a leafy latticework 60 or 70 feet above us and almost shut out the daylight. It was very quiet as we pushed our way through the brush, but one sensed that eyes were all about; mostly the eyes of harmless creatures, but we knew that at any moment a surly tiger might speak up.

We saw few animals. My two Norwegian friends, indeed, had never laid eyes on a tiger, though they had put up a set gun on a tiger trail. Often close to camp there would be a rush through a bunch of grass, followed by a low "woof." Moda, who led the way along the game trails, would stop short. Another "woof" and Moda, who could not be deceived twice, said, "Pig," and we went on with a laugh. It is not always easy to distinguish at first between the startled grunt of a pig and the low rasp of a tiger.

Hours and hours went by as we footed along the game trails, but we never relaxed our vigilance, alert for a tiger or at least a banteng bull. Behind Moda and myself five or six boys followed to bring back any game we might kill.

Sometimes what appeared to be the butt of a fallen tree shifted itself before one could bring gun to shoulder into the disappearing form of a banteng, which in a few bounds would vanish like a ghost into the heavy shadows. This happened a number of times, and once we flushed a banteng and a rhinoceros very close together. A quick shot at the banteng as he turned his head my way brought no results. The rhino thundered away without giving us even a glimpse.

Still we watched and waited. Several mornings when we looked over the large *alang alang* swamp a good distance from home, all we got was a glimpse of a small herd of galloping *sapis,* heifer bantengs. What I wanted was one of the bulls, which sometimes weigh 2000 pounds and could easily be accounted dangerous at close quarters.

And one day the signs were right. As we approached the *alang alang* stretches, such wind as there was blew gently by us from the high grass. And there within easy distance and silhouetted against this moving background of yellow grass, stood a magnificent banteng bull.

He was unconscious of danger. The lower part of his body was screened by deep cover; he was peacefully grazing. Moda whispered, "Banteng," and we gazed in wonder. It seemed a pity to blur the beautiful morning with the crack of a rifle, but in those days of mine, actions were more important than beauty.

Swift death

The banteng never knew what struck him, I am glad to say. The little Mauser did the trick neatly. When we came up to him in the tall grass, his very mass lying there was tremendous, and his grand black head, jet black flanks and white stockings shone resplendent in the morning light—in all, an impressive example of vital masculinity.

Whenever we came to a spot where several banteng had scattered at our approach, a marvelous smell clung to the air. It had definite quality and substance to it. So solid was that odor that one felt it would possess this particular spot as long as the forest lasted. It was the smell of rich new-mown hay, and it came from the wild, steaming breath of the banteng. One gets something of the same effect in a modern barn on a dairy farm when the cows are chewing their cuds.

And still I could not come up with a tiger, at least to see him. One day Moda and I were held up suddenly by a snarl, and although we had heard tigers talk before, this one was very near and meant mischief. He was well hidden in the brush. Moda and the Malay boys looked at me to see how I would take it. Their childish faces showed no fear. For some reason they seemed to trust me utterly. Mine was not an enviable position, but I managed a frozen smile of would-be confidence.

Another and louder snarl came from under a small

tree. The tiger sounded hungry. We could not see even the flicker of a leaf, and in another instant that grating warning rang with the impatience of anger. A deep-throated growl told us to be gone or perhaps the life of one of us might be forfeited for this encroachment. After all, this was his jungle.

There was no hope of crowding the tiger farther. If I walked toward him through the brush he would leap, and I would have to take a chance on picking him out of the air. That was dangerous enough; yet if we tried to retreat, he would take the last man in our line, for such is the habit of these tigers.

Cunning vs. *strength*

The immediate danger we were in sharpened my senses as though I regained all the shrewdness of a prehistoric hunter again. It was as if my sleeping ancestors suddenly awakened and showed me a way out of danger. For I decided neither to force the issue nor retreat. Without hesitation, I went on through the brush, but out of the line of the tiger and to the left. My boys trailed close behind me, and we neither opposed him nor ran away.

This was a new game and a grand one, with the tiger left out like that. He had never been left out before. Animals had always fled from him, but here was one that paid no attention to him. He couldn't understand a move like this; it left him out of the field of battle and deep in doubt. A trap, he thought likely, and decided to play safe. Even for a tiger, elemental forces were getting too jammed, and with a parting snarl he drew silently away into the forest.

All tensions loosened with the going of the tiger; the quiet that followed gave us a feeling of having been dropped into a huge place of enormous silences without life.

My move had broken the jam we were in, for all cats understand traps. They are trappers themselves and take nothing for granted. Tiger hunting is always a kind of game. Though lions and tigers are both great hunters, a tiger is much more the stealthy, cautious cat; the lion is an honest gentleman by comparison.

After this adventure, Captain Sem and I decided that if I were really to bag one of these fellows, it would be better to carry the hunt to a place we knew about farther down the coast. An Austrian had told me about it. I had met him in the suburbs of Batavia hobbling around in the small flower garden by his native house. He had picked one particular jungle spot as the best tiger ground in the peninsula and, brave man that he was, had hoped to sell tiger skins for a living. But he had been caught by the leg one night in one of his own iron-jawed tiger traps. Later he lost the leg and was obliged to stump about on a crutch.

Under the spell of his imaginative tongue, I could see the district crawling with tigers, and that was exactly what I was seeking. I was tiger mad, and it was all to the good that the thicker they were the more dangerous, for a tiger lived on meat and we humans are said to be sweet and tasty. Surely the place the Austrian had told me about would give us an even better chance to study these animals.

My schooner had been sent to Labuan for luxuries, but when it returned we made ready to set off in the old tub for the Java Head lighthouse. Before starting, however, we feasted for several days upon the cargo, reveling in ancient Chinese eggs and drinking some good bottled beer.

The eggs, which had been buried in the ground some twelve years, were thoroughly dried out and mealy, without any sulphur smell, and added much to the flavor of our palm heart salads.

Primitive refrigerator

We cooled the beer by tatting the bottles into palm leaves, soaking them well in water, and swinging them by a cord so that they hung down from the porch of the boys' house. A Malay fastened one end of the cord to the swinging bottle and the other to his big toe. Then his leg was put into action, the bottle swung back and forth in the hot sun, and we had a perfect cooling plant by evaporation.

At last one day we set sail and coasted westward with a favoring breeze behind us. Our boat was not so good on the tack, but in a few hours we anchored off Oodjung Colon stream where we intended to build a base camp for our tiger hunt.

Many wild banana trees, some with ten-inch stems, were quickly cut down and stacked on the ground. Cutting through a banana stem is a good deal like cutting through Swiss cheese, and our cabin was up in no time. Shaggy with so many long leaves left on the stems, in color and lack of architecture it seemed a part of the jungle. A doorway was left, a rough lean-to door adjusted, and inside a long platform bed was added for the captain and me. We festooned a mosquito net over the bed, spread some blankets on the platform and were ready for the night.

But what a night for me! Captain Sem turned out to be the log rolling variety of sleeper; he rolled most of the night, against the cabin wall, against me, against anything which lay in his uncharted course. To push him away, to elbow him, meant nothing. He immediately returned to the attack.

It became a serious matter; something had to be done. I had to have my sleep. The Captain was calm,

unworried. He carried more weight and was better adapted for bumping in a heavyweight class. However, a brilliant thought occurred to me, why not give him something to bump worthy of his size? I placed the heaviest banana stem I could find in the middle of the bed longitudinally. The next night I heard the same bumps and groans, yes, but the barrage was being laid down a safe distance from me. I never was bumped again.

Hunting "small game"

During the day, mosquitoes would crawl inside the net, and at night I hunted them down with a lighted candle and scorched them without burning the net. It was good hunting, this mosquito nipping, and added to the general gaiety of our evenings. This little ceremony over, our cabin housed a happy family.

Our base camp seemed all that the Austrian had promised, the center of a real jungle wilderness. We were monarchs of swamps, jungles, rivers, the Sunda Straits and the creatures which blest those locales: crocodiles, snakes, hermit crabs, barking deer, rhino (*R. sondaicus*), banteng and tigers.

There were no Javanese villages about, and the only wayfarers were bird-nesters, bound for the hills beyond in quest of celebrated nests which drip with the saliva of certain birds. These are the nests from which delicious treacle is later soaked out by Chinese merchants and converted into the famous birds' nest soup.

One day when we visited the lighthouse keeper at Java Head, he told us that early one morning when he walked out of his door he almost stepped on a tiger lying calmly asleep on the step. The smell of man had not bothered him at all, though when the man appeared, the startled animal made off into the brush.

It looked hopeful for us. Moda and I found the country much to our liking, with the tracks of a variety of animals to follow up. Hardly did we leave the cabin behind before signs of game met the eye, and with so much game there were sure to be tigers.

Early one morning, Moda and I left camp and stole silently along from the marshy lowland near the shore toward the grass-covered swales farther inland in the general direction of a dark mass of forest. Out in the Straits, Mount Krakatoa was smoking leisurely into the summer air—Old Krakatoa who blew up so violently back in 1883. Half of the ancient mountain was thrown up into the sky that day, and when it fell back into the sea it drove a huge tidal wave onto the Java coast, covering it far and wide with small pieces of pumice and rushing madly through the jungle. Great forest trees were ripped and torn down as the water made its headlong rush across the little peninsula. So many villages were destroyed and so much wild game, that the famished tigers began killing human beings. It became so dangerous a place that the authorities in Batavia ordered the natives to move eastward nearer civilization.

And here I was, years later, with Moda and the boys, trying to make an attack on this same nest of tigers who had eaten of human flesh and no doubt were hungry for more.

Into the sunlight we held our way across the flats. A flock of peacocks, perhaps half a dozen, the cocks with their fans spread, whirred up from the scattered bushes. The inland forest, densely packed with lofty trees, showed up on our near left. And suddenly monkeys screamed from the treetops as we approached, evidently sent into a panic by a tiger below. Moda spoke one word softly in my ear, "Marchand," Malay for tiger.

Very softly now, each footstep carefully placed, Moda led me to the top of a low ridge. On the crest of it we stepped into a narrow game trail where the high grass had been trodden flat. In the soft earth of this path were fresh, round pugs with sharp nail-prints. Moda looked at me, no word necessary, and we started forward.

Stripes

We had gone only a few steps, however, before we stopped as though at a word of command. There on the level below us in the high yellow grass, a tiger's head showed like a shining spot of light against the tawny grass; he was no more than 60 yards away.

Neither of us was really afraid. The tiger appeared to express merely the greatest astonishment and curiosity. Probably he had never seen a white man before. The big hat and khaki clothes were new to him—very different from the brown shadows of the natives.

Then the big-cat's eyes met mine and held on as if we were searching each other out for signs of either mastery or fear, A great silence fell between us. With mouth shut tight, he seemed to be swallowing me with his eyes, which burned like live flame. As we stood at gaze, very much composed, I seemed to be looking at a beautiful painting with a vague background of that sea of sunburnt grass and the scattered palm trees, its focal point the immobile stance of the tiger with his hazel eyes, which looked so golden in the light, boring into mine.

Hypnotic gaze

Through this gaze we were exchanging there ran an invisible something, like a band which could give and take and even oscillate with the greatest precision between us. The magnetism which a tiger can throw

out from his eyes is amazing, almost as though he projected his own electricity into the atmosphere.

His is a long inheritance of craftiness going way back to old sabertooth himself of prehistoric times. From birth he is in training as a jungle hunter, under the necessity of feeding himself and his young on creatures weak but wary. It has forced him to make a study of hypnotism. It is part of the art of his hunting, and now I could feel what it is like almost to be pulled to him by the devouring magnetic force of his gaze.

Never have I seen another of God's wild creatures who took more pleasure out of paralyzing other animals before chopping down with the death stroke. Sadistic humans, perhaps, run the tiger a close second.

Such concentration, compressing more and more the hearts, the brains, the very God-given creative forces of our beings, could not last long. Perhaps as a survival action, certainly without thought, my rifle slipped to my shoulder, the sights on the tiger's forehead. At the crack of the gun, his head disappeared in a flash.

The life had gone out of the painting. There was only a somber scene of grass and palm trees. The tiger seemed to have left the face of the earth. Not a movement in the grass, not a sound betrayed him. It was nervous business: we would have to advance and find him.

As if alone on the earth, in a small, ever-narrowing circle, Moda and I stole toward a palm tree between us and where the animal had disappeared. Like a monkey, Moda climbed the tree and stopped at a point just below the fronds to search with keen eyes the tall grass beyond. A shake of his head and he was beside me again.

Another 20 feet we stole forward, and he climbed another palm. This time he nodded and pointed to the shotgun we always carried along. One of the boys passed it up to him. A blast of big shot, and down came Moda, nodding his head, smiling broadly. The tiger must be dead by now, I thought, but it was with the utmost caution that we all approached a depression in the grass.

Yes, he was down, but his switching tail called for another shot. Moda had missed, but my Mauser bullet found a spot between the eyes and we could approach in safety.

End of the hunt

He lay there, the island tiger I wanted. His orange and black stripes lost themselves in the shadow and color of the narrow yellow blades around him. Eagerly we bent over to examine and exult; the boys ran forward full of jubilee and animation, to make him ready for carrying back to our camp. He had the very short hair of his kind, the most southern tigers in the world.

I had got him; I was free; free to go on with the next of my adventures and researches into the color patterns and temperaments of tigers. I could go on to Persia for a try at the Mazanderan tigers there. And in a few days I had sailed.

But that did not mean I could shrug off and forget this experience. For a long time I was haunted with a wondrous kind of inarticulate thrill, by that wild gaze, that long, magnetic communication when for those timeless seconds I had the luck to stand eye to eye with the tiger of Java Head.

Why haven't I been told . . . ?

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1

1 Peering into the funnel web from above, one can frequently see the spider in the daytime remaining near the lower end of the tube, which may be ten inches or more long. Often, however, the creature rests just inside the narrow opening, waiting for some insect to become entangled in the network of silken threads overhead.

The threads are not sticky. They serve only to confuse the insect that flies against them. When once the insect falls to the sheet-like web below, the spider quickly captures and kills it. Only the body fluids are eaten, being sucked from the insect through wounds made by the fangs of the spider.

Each time the spider passes over its sheet-like web, it leaves a silken thread. These threads in time cause the surface of the sheet to become more and more unyielding. The narrowing part of the nest receives a greater amount of silk than do the outer portions.

Grass spiders vary greatly in size and color. Large females may have an over-all diameter of more than two inches, whereas females of other species may reach only half that size. Some are pale yellow with gray markings, others reddish-brown with markings almost black. The males are as large as the females, with longer legs and smaller abdomen.

2

2 The mit-like appendages of this immature male, somewhat resembling boxing gloves, are the pedipalps, which are secondary sexual organs. Spiders are not insects, and these appendages are one of a number of features causing them to be classed as arachnids, which include scorpions and their allies.

The spider shown in this photograph was attracted to the entrance of his nest when a tiny pellet was dropped upon the web, causing it to vibrate. Grass spiders can usually be made to run out onto the sheet-like web by any disturbance giving promise of an insect to be captured.

But the spider is wary of certain predatory wasps which seek to capture him as food for their offspring. The spider flees from such a wasp through the opening at the lower end of the web tube. Often, however, the wasp follows the spider through the opening and is sometimes successful in making the capture.

The Funnel-Web Spider

A Picture Story By LEE PASSMORE

"Come into my parlor"—an open invitation to a horde of luckless insects but not to the wasp who comes on a murderous errand

HARMLESS TO MAN and serving a worthy purpose in the balanced scheme of Nature, the funnel-web spiders are conspicuous to the stroller of the countryside for their characteristic webs of sheet-like silk. When covered with dew, these "traps" show up prominently close to the ground, where they are attached to grass, weeds, or sometimes to hedges a few feet high. It is in this funnel-shaped web that the spider captures the insects on which it feeds and seeks escape from its many enemies. At the foot of the funnel the spider spins the silken sac in which it lays its eggs.

These so-called grass spiders are among the most common of all spiders in the United States. The one whose life is shown here, *Agelena aperta* Gertsch, is one of the largest and commonest species found in the southwestern United States, and is a representative member of the funnel-web family.

3 THE PEDIPALPS (or genital organs) are clearly shown in this photograph of an immature male. The male becomes sexually mature after the last moult, sometime in the late summer or early fall, after which mating occurs. Before the male leaves his nest to go in search of females, he spins a silken web and thereon discharges the all-important droplets of reproductive fluid. This fertilizing fluid is then drawn into these palpal bulbs. Having thus charged them, he is ready to fertilize the eggs of the female and thereby assure the continuance of the species.

Spiders have their skeletons on the outside, and in order to increase in size they must cast the outer skin. This process is called moulting. A new skin is sufficiently developed underneath to support the creature when the old one is discarded. The process is repeated a definite number of times for each species. In this picture of a male in the penultimate or next-to-last stage, the discarded "outside skeleton" is shown just to the right.

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4-5-6 FUNNEL WEB in three photographs. At top is shown the funnel-shaped upper structure. The second picture shows the tube leading downward through the grass and weeds. The third view shows the egg-sac, which is supported by several branches a few inches above the ground, where it will remain undamaged even though the ground becomes flooded. The outer surfaces of the egg-sac are strengthened by particles of earth and bits of dry sticks intermingled with loose web. Within this the living spiderlings have protection after hatching.

7 A GREAT AMOUNT OF SILK is used in making the egg-sac. In the beginning the sac is shaped like a tiny saucer, only about one inch across but large enough to hold about 100 delicate, velvety, cream-colored eggs. Over the eggs the spider weaves a thick coating of silk. This is shaped to fit the lower half containing the eggs; and the edges of the two halves are bound together. The sac is now disk-like. The spider continues spinning a less closely woven web around the sac until it is about three-quarters of an inch thick.

•

8 WHEN THE SPIDERLINGS emerge from the soft egg shells, they look like tiny white pearls, each equipped with eight legs constantly in motion. The hatching occurs in September or October in southern California. Now, in midwinter, many broods of funnel-web spiderlings are waiting snugly in their silken nests until more friendly weather. During this period they do not grow

7

larger; otherwise the sac would become too small for their comfort.

•

9 Early in May the spiderlings make an opening in the egg-sac and emerge. Soon they begin building tiny funnel-web nests for themselves, which without instruction or example they make as perfectly as their parents did, only on a much smaller scale. They take very small insects at first, but rapidly become strong enough to capture large ones.

The mother spider guards her egg-sac until her life span is ended. Her shriveled remains are often found lying near the empty egg-sac from which the young have since departed.

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10 Jewels of dew. The myriad droplets on the sheet-like web reflect the rays of the morning sun like a cloth of diamonds or pearls, a fascinating work of Nature upon which one gazes with admiration.

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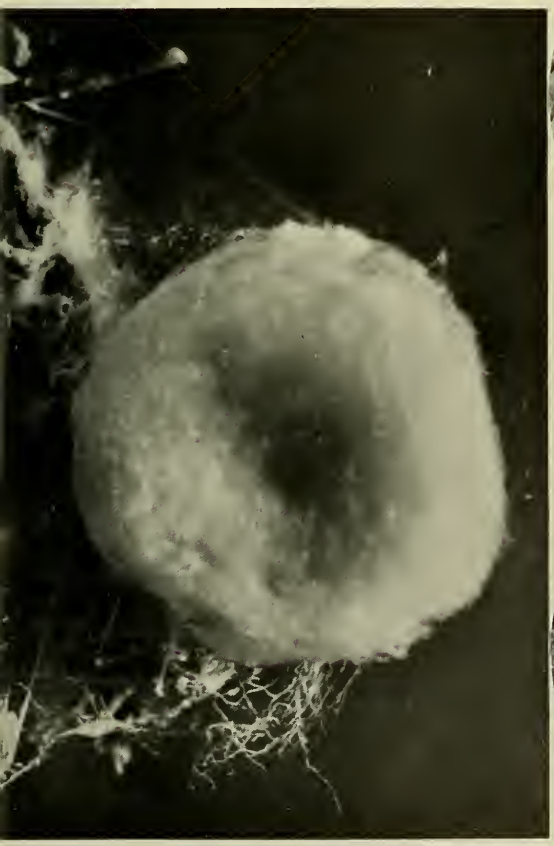

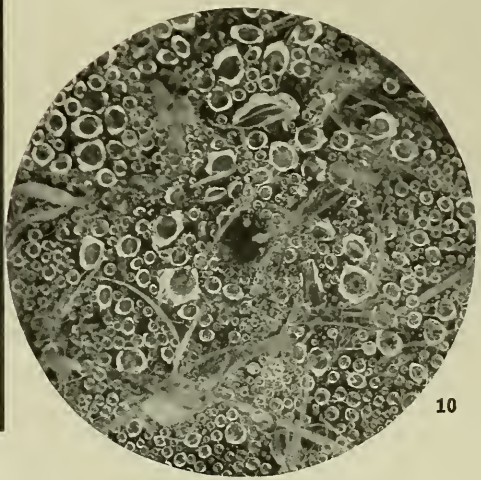

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(From Jean de La Fontaine's Fables Choisies, Paris, 1759 Edition)

In ancient legend the rat is given credit for the ingenious trick of transporting eggs as shown above. Modern testimony indicates that he may after all do this

THE STORY *that monkeys will cross an alligator infested stream by forming a living bridge has persisted into recent times* (From Homes' Fourth Reader, 1897)

ANIMAL FABLES

By W. LEY

How many commonly accepted superstitions about animals could you confidently deny?

FEBRUARY SECOND is the day made famous by the ground hog. Each year we are reminded of his reputation for retreating underground at sight of his shadow, and we wonder, momentarily at least, whether the legend may not after all be true. It is no discredit to the ground hog or to Nature in all her mysterious workings that it is not. But we may well take it as a reminder that we should periodically take stock of our natural history beliefs to see how well we know the true from the false.

All of us have been told sometime that toads cause warts, that shaving encourages the growth of hair, and that a person's fingernails keep on growing after he is dead. None of these beliefs is true, but they are lively superstitions. Hair that is freshly shaven may be sharper, and therefore, feel longer, and the fingernails of a mummy may appear longer than normal because the flesh has shrunken; but there is no real growth.

Likewise we are familiar with the story of the unfortunate white parents who gave birth to a coal black baby, because one of them, perhaps without knowing it, had "one drop of Negro blood." From the prevalence of this belief, one might suppose the occurrence to be reasonably common. But the laws of heredity make it practically an impossibility for white parents to give birth to a black child, and it is doubtful if an example to fit the story ever occurred.

Fear or other strong emotion is often the food on which superstitions feed long after intelligent reasoning shows them to be without further foundation. Strange superstitions of nature have always been plentiful and they are characteristically obstinate,

doubtless because truth in nature is often stranger than fiction.

Belief that an ostrich when frightened sticks its head in the sand has been traced clear back to Roman times. Through 20 centuries and in the face of all reason, millions of people have defended this belief, while the ostrich, unmindful of the excellent example he has given man, goes about his business without ever thinking of sticking his head in the sand.

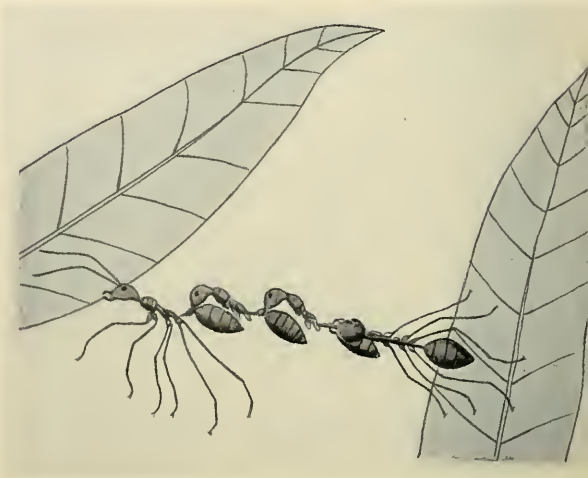
In the stern world of facts, where lions and other predatory animals are ready to eliminate a bird so foolish, the ostrich would in all probability long ago have disappeared from the earth if it actually did this at the approach of danger.

But animals have just as readily supplied man with illustrations of astonishing ingenuity. We have the example of the hungry rat which, after searching vainly, finds one of his favorite foods, a hen's egg. Unable alone to transport it to safety, he is confronted with a difficult engineering problem. But fortunately for the rat's needs, as well as for our love of the picturesque, he finds a way. He lies down on his back and holds the egg with all four paws; then he allows one or two of his brothers to drag him by the tail like a sled. Are we to believe this or not?

The same method is ascribed to beavers and badgers for the carrying of hay or wood, and in this form the story dates from Roman times. It appears for the first time in Pliny the Elder's *Natural History* and was even then taken from older sources we cannot trace. As applied to the rat, it probably appeared first in European literature in 1678 in La Fontaine's fable, "The Two Rats, the Fox, and the Egg." La Fontaine was blamed for having freely invented this fable to contradict the philosophy of Descartes and to convince people that animals are capable of intelligent action. He did not invent it, however, but probably got it from India.[1]

Dr. E. W. Gudger has investigated the facts of this story. He discovered another early version in a Persian manuscript, written by one otherwise unknown Ibn Bakhtishu and entitled *Manafi al-Hayawan,* "Description of Animals," which was finished in 1291 A. D. In this manuscript, now in Pierpont Morgan Library in New York City, there is even a picture of two rats transporting an egg in the manner described. But he found a number of fairly recent and apparently sincere reports in various journals.

Inquiry soon brought support for these in eyewitness accounts, one of which came from Mr. Arch E. Scott at Stony Point, on the Hudson River.[2] In September, 1929, the continued disappearance of eggs and the frequent appearance of broken shells around the door of the henhouse led to the suspicion that rats were the culprits. Mr. Scott chose a bright moonlight night to keep watch from an overhead beam. As bait a very white egg was put out. In about an hour two rats appeared. The egg was in a box seven inches deep, and rat A, on the edge of the box, apparently lifted rat B, which was clutching the egg to his belly, out of the box and lowered him to the floor. "Rat A jumped down, took the tail of rat B crosswise in his mouth and dragged rat B across the six feet of illuminated space. In doing this, rat A walked forward and had the tail of rat B over his shoulder and the body of rat B close beside him."



(Above) CERTAIN *ants accomplish what has been untruthfully ascribed to monkeys: a living bridge*
(Doflein, after Auguste Forel)

Regarding the rat-egg-transport, Doctor Gudger faithfully and accurately reports the evidence he has gathered and says, "Believe it or not." To see whether any additional evidence could be found in other countries, the present writer published a short summary of all this in the European magazine, *Kosmos.* Out of 35 letters received within a few weeks, three contained eyewitness accounts, while others referred to narratives of close friends or relatives.

One of the eyewitnesses was a lady in Syke near Bremen, Germany. She had seen the rat-egg-cart in her backyard in 1933 from a distance of about 15 feet. The second eyewitness had seen such a transport in Baden in about 1910; and the third, a school teacher in Innsbruck, had seen it as a boy in his city in about 1906.

When confronted with a wall too high or smooth to climb, rats have also been said to build "stepladders" or pyramids, one animal climbing on top of another. They were believed to form living chains to descend from high places; and when unable to get honey or other food out of a narrow-necked bottle, to use their tails as a child uses its finger. But these stories lack proof and are not to be swallowed whole.

The correspondence I just mentioned brought some evidence for the pyramid, and several persons mentioned the use of the tail in bottles, but without having actually seen it. The living chain was almost unanimously called a fable.

The "living chain" has also been ascribed to monkeys. The story is that a band of monkeys are stopped by a river. One monkey firmly anchors itself on a stout branch of a tree; another grips its legs, and so on until a long chain is formed. The chain then begins to swing like a pendulum and the monkey at the lower end is finally able to get hold of a branch on the other side. The remainder of the band, mainly females and young, cross the living bridge. Finally the bridge is broken by the first monkey letting go.

It seems too bad that this pretty story has to be labeled untrue, but the combined weights of such monkeys would make a burden unbearable for the first link.[3]

A somewhat similar story, that of the elephant bridge, goes clear back to Aelian, a Roman writer who flourished about 120 A. D. He told that elephants, if they want to cross a deep ditch, use one of their number as a steppingstone. A large elephant was supposed to jump into the ditch allowing the others to pass, stepping on its back. After all had passed, they were said to throw dry branches, or whatever they could find, into the ditch to give the first an opportunity to crawl out. While this story is almost certainly a fable, the African explorer, Wissmann, did observe that an elephant cow threw branches into a pit in which a young one had been caught.

Aelian also told that wolves, when trying to cross a fast-flowing river, bite each other's tails to make sure that none is carried away. This makes a nice picture but is unconfirmed and far from probable.

One creature, at least, can be safely credited with the ability to build bridges, both pontoon and suspension: the ant. A stream cannot stop a horde of *Anomma* when they are on their hunting expeditions in Africa, as explained by Auguste Forel.[4] From some object projecting from one bank they link themselves together in a chain and find some support on the opposite bank—a stone, twig, or grass blade. Making fast to this object, the chain spreads out, and the whole greedy robber-army passes over the living bridge, to continue their depredations on the other side.

A remarkable suspension bridge is formed on occasion by certain ants of the subfamily *Formicinae* when the leaves between which they are building their nest are too far apart for a single ant to reach. The engineering is the more wonderful when we realize that the adult ants themselves do not produce the silk with which they ultimately join the two leaves but utilize their own larvae for this, as a weaver uses his shuttle. Every worker seizes a larva, which under gentle pressure of the mandibles emits the fluid that hardens into a thread on contact with the air. Thus equipped, the squad attacks the problem of joining the leaves. The ants form chains, each ant taking hold of another at the slender abdominal segment, until the first is able to hold one end of one leaf-edge in her mandibles, and the last to hold the other edge between her six legs. They then pull the two leaves toward each other, and the squad of weavers undertakes construction of the silken nest between, using the bridge to cross back and forth when necessary.[5]

More than two centuries ago a scientist studied the life of the bumblebees. When out walking one early dawn, he found a nest of bumblebees in the ground. He watched and saw to his surprise that one especially large and strong bumblebee was sitting alone at the entrance of the nest and beating its wings noisily. It did not fly away, just sat and beat its wings for about half an hour. Other bumblebees appeared, as if aroused by the noise, and began to go about their daily tasks. When everyone seemed awake, the first bumblebee folded its wings and crawled inside as if exhausted.

The scientist was greatly surprised. He observed again the next morning that the result was the same. This justified his announcement of the "bumblebee bugler," the bumblebee that wakes up first and then makes noise until the whole nest is awake.

The announcement created considerable interest. Some observers declared that, however hard they looked, they could not find the "bugler"; others pointed out that various members of the community were already awake and busily working when the "bugler" started beating its wings. It took some time for the controversy about the bumblebee "bugler" to be finally settled. The facts are right, but they had been misinterpreted. It was exactly as if bumblebees observing humanity would report that the humans make electric fans to enjoy the sound they produce. What the "bugler" really does is to ventilate the nest which has been dampened by dew. The noise made by the ventilator is only incidental, although it might conceivably help to arouse the others.

Continued on page 122

"PINKY," *the kewpie-like Wa-Kindiga first seen by the expedition after a long search in an inaccessible section of East Africa. The author's gun bearer (right) obviously finds Pinky one of the strangest natives he has ever seen*

WE LIVE WITH THE WA-KINDIGAS—*A visit among these shy and elusive primitives, possibly remnants of Africa's earliest aboriginal inhabitants, was like a journey into an early chapter of human history*

By JULIE B. MORSE
Morse Museum
Warren, N. H.

OUR most important field work during the 1938 Africa-Asiatic Morse Museum Expedition was the finding of an elusive group of Bushmen, known as the Wa-Kindigas, in Tanganyika, British East Africa. And as we are according to any information obtainable the only expedition to have lived among them, I am glad to give an account of our experience with them.

I am assured by H. J. Braunholtz of the staff of the British Museum in London that up to now any information about these people has been exceedingly slight and sketchy, and that our photographs and notes have added an important link in the study of African Bushmen. The British Museum was anxious to obtain some of our curios, but we had already presented what we felt we could spare to the American Museum of Natural History.

The Wa-Kindigas, or Natzabie as they call themselves, are found in scattered, small groups near the

mountainous area about Lake Eyassi in Northern Tanganyika. They are believed to be remnants of the earliest aboriginal inhabitants of East Africa. Probably related to Pygmy or Bushman stock, they are no longer a pure strain but undoubtedly united with Bantu and other immigrants, although they retain in their speech the "click" peculiar to Bushmen.

At the moment the whole population totals only a few hundreds—a people so timid and shy as to have been seen by few white men. They have no huts but exist simply under large trees, around which they pull a slight brush shelter. This rude home does for dry weather. In the rainy season they take to large caves in the mountains surrounding the lake.

In 1935 our expedition to East Africa heard varying rumors of this tribe, and we greatly wished to find and photograph them then. But although everyone admitted that such people existed, we could find no one who actually had ever seen them. They were almost legendary. We were utterly unsuccessful that year in our efforts to verify even the locality in which they might be found, which seemed strange in an area fairly settled.

Last year one of the major interests of the expedition was the search for the Wa-Kindigas, and we determined to leave no stone unturned.

In spite of constant inquiry we were almost disappointed again when Christopher Schultz, sole licensed agent to capture animals alive for export out of Tanganyika, told us that, while capturing young rhino near Lake Eyassi, he had several times run across the old headman, Iyaidi (or so it sounded) of the Wa-Kindigas, with whom he had made friends. This was a lead. Shortly after that, we met a fine young Dutch hunter, Ben Fourie, who with Baron Blixen, had some years before found a small group of them which he had photographed. This was luck indeed. So, although Ben warned us that it would not be easy to make contact with these natives, who greatly feared to be seen, he believed he could help us.

Ben set about consulting many natives in the neighborhood where he had formerly seen the Wa-Kindigas, finally discovering a subchief of another tribe, the Mbulu, who knew a good deal about them. Natives always placed great faith in Ben, and he managed to elicit information where we and others even in official capacity failed.

The Mbulu subchief was loathe to give away the present whereabouts of the wild tribe. It eventually appeared to be certain that the Mbulus held a more or less protective interest in the Wa-Kindigas because the wild tribe provided the Mbulus with meat in greater quantities than they themselves could possibly have acquired without running afoul of the game authorities. It is possible, too, that the wild tribe provided some of their potent arrow poison, such as we later saw used and brought away with us.

(Above) BELIEVED *to be related to Pygmy or Bushman stock, the Wa-Kindigas inhabit an isolated section in British East Africa*

At any rate, after several days of persuasion, Ben reported that the subchief would send out to call in one of the Wa-Kindigas to his hut. Our duty then was to arrive with presents galore to tempt. The Wa-Kindiga would then go back to his people to tell them what a grand experience awaited them if they would only permit us to pay them a visit. "White men with wonderful presents" was to be his message. Coveted gifts also were promised to the Mbulu subchief when and if he produced.

Thus it came about that one evening just after dark a runner burst into our camp near Maji Moto, beneath the Great Rift Wall, where we were photographing elephants. The boy was well winded and

(Left) "AFTER THE DANCE," *writes Julie B. Morse, "we 'girls' sat apart while our warriors prepared garlands of bloody meat from a hippo killed for the occasion"*

very perturbed. He had covered 30 miles in double-quick time. His chief had told him to hurry to Bwana Ben and say that there was a Wa-Kindiga at his hut but that the chief was having a most anxious time holding the fellow, who was mortally scared. The chief didn't want to chance his getting too frightened, so he begged Bwana Ben to hurry back with the presents.

Although it was night and a far longer route by road than across country as the runner had traveled, we hurriedly filled a car with blankets, fancy knives, tobacco, and shiny jewelry. Ben set out at once alone. Alone, because we agreed that one white person would be less disconcerting than three to an already jittery Wa-Kindiga.

Ben's own story of that encounter was amusing. As he neared the chief's hut, he spied, standing on an ant hill, a native who, in seeing him in the car, sped off into the night toward the compound. A second and a third native went through the same performance. His coming was evidently awaited anxiously indeed.

A great clacking of teeth

As Ben stopped the car at some distance from the hut, several Mbulus stepped toward him with a short greeting of *"Pesi, pesi, Bwana."* (Hurry, hurry.) Ben was thrust without ceremony through the doorway, where a harassed young chieftain showed unusual relief on his heretofore poker face. In the far corner of the hut glowering and snapping his teeth together with clucking sounds as if he were crunching bones, a figure could be dimly seen that looked like a native but sounded unearthly. Garbed in a strip of cat tail and a beaded headband, the Wa-Kindiga crouched, clutching his bow and arrows. Said Ben, "I remembered all I had heard of the bad poison those natives use."

The weary chief pointed to the wild man ana shrugged his shoulders. Said Ben, "I tried to smile and stepped toward the fellow. He leaped up as he backed against the wall. In that flickering lamplight it all seemed like some strange picture. I didn't know just what to do for fear he would shoot off one of his arrows. Neither of us liked it a bit. I thought for a second, and then quietly went to the door to tell a boy to bring in the presents from the car. I stayed out of sight until he had dropped them all in front of the Wa-Kindiga, who stopped his clucking for a minute and stared at the pile.

"Rapidly I told the Mbulu to tell him that some of this was for him, the rest for his people if he would be my friend. Down to the ground he dropped, grabbing at the tobacco first. He gathered it all up into a blanket and started for the door, cat tail straight out behind him. But the Mbulu was there before him talking very fast and blocking the exit. What they said, clicking back and forth at each other, I don't know; finally the Wa-Kindiga consented to be led back, and we all sat down around the pile of presents for *shauri* (negotiations). The Wa-Kindiga never did relax and kept looking toward the door. After the Mbulu had talked and talked, he told me that the Wa-Kindiga agreed to take his own presents back to the tribe, and that if they were willing, we could meet them near an old hippo hole by Lake Eyassi."

When Ben had finished his story, he added that the Mbulu would send us word when to go there. There seemed nothing more to be done so we waited, not quite trusting that fellow to keep his word.

All this made us more anxious than ever to see a tribe that hadn't become used to white men and their ways as to be blasé. For while all tribes are interesting and most still live in their old primitive fashion, they have developed outstretched hands for "shillingys." Children learn to cry "bakshishi" very early now.

We hunted and waited, collected beaded skirts from the Mbugwes, jewelry from Masai, witnessed ceremonies and *ngomas* (dances), and photographed the numerous herds of animals.

Then one day came the word. We broke camp at once and started for Lake Eyassi beyond the German colony of Oldeani. From that sparse settlement there was no proper road but a lorry track that could be negotiated well enough in dry weather. As we journeyed along we saw little reason why or how a tribe living within 30 miles of civilization's outskirts could remain such a mystery to the world. How could they remain hidden so well? We found that out later.

This was now what is known in Africa as typical rhino country, hilly, sparsely covered with dried-up thorn trees. But ahead of us, beyond the lake, impressive mountain ranges towered into the sky, looking thick with growth in the distance. We saw no sign of human habitation or life other than a few startled antelope, a rhino which went cantering away, frightened by our noisy engines, and two groups of natives returning with many small packages of salt carried on long poles across their shoulders from many days' walk beyond Lake Eyassi.

We camped on the brow of a hill overlooking the old hippo hole down by the lake. Four Mbulu scouts sent out by the young chief came in the next morning with the bad news that they had scoured the whole terrain for two days without finding any signs of the elusive Wa-Kindigas except the warm embers of their camp fires. We were disgusted. The Mbulus were unconcerned, as they agreed that by now the Wa-Kindigas were probably far, far into the hills where it was hopeless to try to find them.

As we gazed at the many towering peaks stretching for miles and miles, we, too, agreed that it was pretty useless. But there we were, so we sent one of the scouts back to the chief with an indignant message and sent the others out for another search. In the meantime we tried to get stills and colored movies of hippos in the thick papyrus swamps nearby.

A few days went by in this way. Then on our return to camp late one afternoon we met our three scouts. With them was the strangest human being we had ever seen. My gun bearer burst into guffaws at the sight, and I had hard work to contain myself.

Why, I do not know, but from that moment on, this apparition, with whom I became quite pally, was "Pinky" to me. Perhaps it was because he was such a roly-poly sort of fellow, who should have been all pink and white instead of chocolate color. On his funny round head he wore a gay, beaded headband, beneath which was a crinkly fat face. His Santa Claus belly sported a natty cat tail for ornament. From his enormous, creased posterior another cat tail switched gaily from side to side. A dark brown kewpie in fact.

He scowled and drew back as I went slowly toward him to make friends. Surely this must be a Wa-Kindiga—and it was. I stopped, carefully lighted a cigarette, puffed a bit, then held out one for Pinky. Dancing school manners he had not. He snatched the cigarette out of my hand, rushed to the camp fire, hauled out a burning brand and, puffing like mad, drew, it seemed, both fire and smoke into his lungs. He was immediately seized with a most violent spell of coughing and strangling which terrified me for fear he would drop dead at once. The cigarette was drawn to a wee butt when Pinky came up smiling.

I suggested, through the Mbulu, that my cigarettes were much too strong, but no, Pinky, with many grunts allowed that they were much too mild. When I put the tin into my pocket, a pathetic, half-pleading look in my wild man's eyes, reminded me of Squawko, our noisy, naughty but lovable baboon.

Smoking marathon

I couldn't resist him, and we grinned broadly at each other as I brought out the smokes once more. Pinky and I were friends. We sat right down on the ground in front of my tent to outsmoke each other. He would grab a fresh one each time, light it with a firebrand, and run back to join me, pulling with one draft the whole thing, while I laughed with glee to see him explode with coughing every time. When I was exhausted, we told the safari boys to take Pinky to the boy's camp fire, feed him heartily on meat, and give him a blanket. We told them to put him between them to sleep, and to watch carefully that he didn't "up and go" in the night. But Pinky went willingly and seemed friendly with everyone but Bacari, my gun bearer, who had laughed at him so heartily at first. To Bacari, the Wa-Kindigas were always just a laugh—not people at all.

One of the boys came later to say that Pinky refused a blanket and was curled up in his skin, and that he "smelled like an old eland." We crept over to take a look, and sure enough, there he was, sleeping heavily near the fire without covering of any kind. The boys watching him looked out at us from their blankets, made wry faces, and indicated that their bedfellow was a bit of a smell.

At dawn Pinky and a Mbulu scout left to prepare the tribe to meet us at a point eighteen miles or so away. The scout returned with the news that the tribe was willing and ready. So the next morning we started out to camp in their area. Then it was that we became aware that it was not peculiar that the Wa-Kindigas could hide away so successfully. For while the going was simply rough that dry day, we passed over miles of black cotton soil and prayed that rain, almost due, would hold off until we had our pictures, else we should have to become members of the Wa-Kindigas in good faith. Certainly no car could have navigated so much cotton soil even in dampish weather.

We wound around the lake first, then up over a steep, trackless hill. There were acres of short brush and thick thorn bushes, which we traversed with great trouble, finding an opening here, clearing a space there. We forded a deep river, then gingerly skirted an area covered with volcanic shale disastrous to tires.

Dark figures

We were always amazed at how quickly our boys sighted objects for which we had to use binoculars. We were still in thick growth when they cried, *"Shoto, Bwana, Wa-Kindigas hapa sasa."* (To the left, Bwana, we are near the Wa-Kindigas.)

We peered and caught glimpses of dark figures darting through the bush. They were running swiftly without effort, carrying unusually long, heavy bows and arrows, as they raced toward us. They hallooed and leaped joyously like impallas at play, but at some distance they suddenly halted, waiting for the car to come up to them. We hallooed, too, and thrust opened tins of Bear cigarettes toward them from each side of the car. Then Pinky appeared, puffing and blowing from his spurt, and he ran up to the car and grabbed a tin. I lighted a cigarette, handed it to him, and he at once fell to smoking and spluttering energetically. The others gathered around and followed suit.

They were young men, not at all like Pinky but slight, well formed and straight. They ranged in shade from light chocolate to quite black; some had cicatricial marks, or scarification, on their arms, and they were catholic in their taste for clothing. Cat tails in front held on by leather thongs were most popular, but a few wore dirty, torn skins draped over one shoulder, or as a short apron. Their ears were not pierced, nor did they wear any gadgets on them. They were pleasant, but had the same look in their eyes that a wild animal has when one is attempting to tame it—an uncertain look which could develop into fright with one wrong move on our part.

We smiled; they smiled as the coughing subsided. Then with one accord, they snatched our hands and we found ourselves being mobbed by this group of about 20, all trying to shake hands at once. They gripped our palms quickly, then slipped fingers to squeeze our thumbs—a clasp used by many tribes. They then fell back and started to run away. The Mbulu said we were to follow them.

All along the route we met Wa-Kindigas running, until old Chief Iyaidi made his appearance. He was a second Pinky but with more dignity along with his pudginess. They were the only two oldsters in the tribe, and while the costume, or lack of it, added to the attractiveness of the young men, it was really grotesque on the old men. Flying cat tails and dignity didn't seem to jibe. But Iyaidi had charm just the same; his handshake was most courteous and his smile a welcoming one. When we invited him to ride in the car, he hesitated only a moment, then clambered in. Then and there I agreed with the boys: he, too, smelled like an old eland. Something of a raw meatish odor came from his body, and later we noticed it with all of them.

Although Iyaidi was not in the least dismayed by his new experience of riding in a car, his followers were excited. We bumped along the uneven ground escorted by a most uproarious gang, yelling, leaping, and generally cavorting around the car as they led us to a spot by the river where we decided to pitch the tents. Our new friends showed their appreciation of everything by guttural grunts and a kind of conversation that seemed to be carried on by means of smacking, clicking and short, shrill cries.

After our first meeting, the Wa-Kindigas were not shy with us again until we asked to have their wives brought to camp. The men were all seated in a group with us when the matter came up, and at once they became restless and uneasy, smacking back and forth at each other uncertainly. And they refused point blank.

Of course the Mbulu, who was the only person who had any idea what they were talking about, was not exactly a first-rate interpreter, and what he made them understand we often wondered. But it was apparent that they weren't pleased. When we continued to try to persuade them, some disappeared into the bush, some sat and looked glum, and others wandered off indifferently to the high bushes, where they proceeded to pick pretty, red berries which they shoved by handfuls into their mouths. I joined the group and picked some berries myself, which were very good.

My husband, I. H., tried to divert attention from the woman question by urging the young men to shoot arrows at a given target. They were loathe to perform, so he picked up the chief's bow and arrows. He received a quick, rough shove and had them grabbed out of his hand in a trice. The Mbulu, however, came to the rescue in good style and smilingly showed the chief that I. H. only wanted to see if it was a good bow. Whereupon Iyaidi generously, and

(Right) A REQUEST *to see the women of the tribe made the Wa-Kindigas withdraw suspiciously. Cordial relations were again established in the friendly rivalry of a bow-and-arrow contest between the expedition and the natives. A special bridge was later built to enable the women to visit the expedition*

with really great courtesy, handed over the bow and arrows, holding back some evidently poisoned ones, as the Mbulu said, *"Mbia, Bwana."* (bad)

I. H. let fly an arrow which fell short of the mark he had chosen, and that was a good thing, for the Wa-Kindigas laughed heartily. One of their men shot true for the mark. That broke the ice once more, and we had quite an exhibition of accurate marksmanship for some time. The bows were very stiff, but when shot properly, sent the arrows with power and speed.

When everyone was friendly again, we sat down for another *shauri*. The Mbulu interpreted that the men wanted meat. "All right," agreed Bwana I. H., "if I get meat for you, will you bring your wives from across the river for the Memsahib so she can give them presents?"

Much smacking and clicking, then a reply somewhat like this: "Well, you see it's this way, we men can wade across the river, although it is deep and swift; but our wives cannot do so, and there is no way for them to come with the babies."

With that Ben walked away. When he returned later, he had found a place where the river did not run too swiftly. By standing in the water up to their armpits, the men could build a crude bridge. That made everything all right. It was agreed that the women should come the next day, after the bridge was built. In the meantime Bwana would kill a hippo if they could find one for him.

They led us to a nearby swamp. Just hidden by a fringe of papyrus was a young hippo, which I. H. shot at once. Using our rope and vines to drag it out, the Wa-Kindigas set about hacking it up with no loss of time, stopping only to bite off a nice gory bit from the knife now and then. The entrails were best appreciated, we thought. One man got quite indignant because another was quick enough to grab a particularly repulsive innard and run with it to a pile of meat he was laying aside for himself. A fight threatened. The victor claimed that his wife liked that part best. The noisy squabble was finally settled by giving the defeated one next choice of tidbits. The whole affair was a success, and we parted from the Wa-Kindigas that afternoon with promises of a happy meeting on the morrow.

Our ears were well worn out by the harsh click-clicking; our hands were limp, as with each smile or new attention, they shook hands with us all around. A good, hot bath would be necessary to free us from the clammy hand touch and the odor that pervaded even our clothes. But we were for the Wa-Kindigas in a big way. They were rough but friendly.

The following morning, near noon, the rude bridge of fallen trees and brush was completed. On the opposite bank a large crowd of children had gathered. We saw no signs of the women but shortly heard haloos and female twitterings. A parade of women, in single file, came from amongst the trees, spurred on by good old Iyaidi and his fine looking, extremely black, eldest son, Sagasi.

Leaving the women to use the bridge, Iyaidi and Sagasi waded over to us, and we shook hands again. The women were timid about trying the bridge. It took the steadying hands of several young men and the hoarse shoutings of Iyaidi to force the first ones over. But eventually, babes on their backs and small ones clinging to their skirts, they, one after another, picked their way to our side and clambered up the bank. The women offered their hands at once to me and then to I. H., but they had trembly hands, and were all shaking and shivery as they stood huddled together. I tried not to notice the mothers then, and patted the children, who fled behind their mothers'

(Left) RIVALRY OVER THE KILL. *The native at left is furious with a fellow tribesman who was quick enough to grab a portion of the innards of the hippo for himself. The natives sampled the raw meat as they carved, and seemed to prize most highly the entrails, which the women carried garlanded about their necks back to camp.*

backs. Only one oldish-looking woman said something to the Mbulu, and he told Ben that she had been in the group that he had photographed some years before. Then a great jabbering was set up, and she became an important person and was shoved forward to shake hands a few more times.

We had come armed with yards of bright tinsel ribbon. This Christmas or candy box ribbon had made a great hit in 1935 and often procured articles we desired when shillings failed. I attempted to tie some around the neck of one child in arms, but the mother fled and others with her. They hid in the long grass until we pretended not to care and paid attention to other things. When they lost their fear, or curiosity got the better of them, they came back near me, fingered my clothes, touched the bright ribbon, and gestured that they would like some tied around their necks.

They were a badly formed lot, not straight and sturdy like the men. Slack breasts and sagging stomachs were common; rounded shoulders, usually rare among native women, showed that they lacked the exercise of carrying waterpots on their heads, or hoeing in the garden. They were slightly less than medium height, except the chief's wife, who was stout, tall and black.

The visit that day was short. After the first novelty wore thin and we hadn't much to do but smile back and forth, smoke together, and look pleasant, one by one the women came to shake hands once more and return to their homes.

Better than our cigarettes, the Wa-Kindigas enjoyed a communal pipe. It was a short, stone bowl without mouthpiece, which every now and then someone would light up. All the others would dash to him. As he dragged smoke deeply and started to cough, another and another snatched it until all were in the throes of those terrible spasms from which they emerged as if it were the greatest fun in the world. The women were less greedy, but the results were the same: coughing spells ending in laughter and another smoke. We wondered if excitement made them do it so often, or if possibly they could see how it entertained us.

So it went, day after day; little by little we became better friends. Iyaidi and Sagasi made a call at dawn each day to see what the day's hunting or doings were to be. We had not tried to "invade" their village, fearing they might just depart for parts unknown. But one day the invitation came, and we were well pleased.

We spent two days building a bridge strong enough to allow us to push the car over the river. We dared not drive it as the water was so swift and the trees we had to use were by no means the largest and most sturdy. But it answered our purposes. It was such an interesting river, too. Not too wide, but deep and swift enough so that hippo lay submerged when they napped, with scarcely a ripple to indicate their breathing.

During these two days, our neighbors hunted with us, gaining a share of the meat, while we studied

(Below) IN A DANCE GIVEN *for the white men, the small boy, no more than four, shown here, danced with his elders, keeping perfect step in all the various movements, distinguishing himself as the best dancer of all*

(Above) LIVING *a furtive, wandering existence almost out of contact even with neighboring tribes, the Wa-Kindigas represent a very primitive stage in African native life*

them. We found that they were rather reckless and needless destroyers of game. They apparently killed often, not for meat but for the sport, and left most of the carcass of fine hippos to rot. Once we found a dead rhino which they declared they knew nothing about; but we doubted their story. It was extraordinary about that rhino, for while it had been dead long enough to smell badly, which was how we happened on it, the vultures had not gathered. In fact, it was the only spot in Africa where I had not seen vultures descend immediately upon a dead animal. I do not know the answer.

It was five miles to the village of the Wa-Kindigas. When we got to the spot where the Mbulu had originally found them, there were no huts or other signs of life. There were a few large trees around the base of which, some light protection of brush had been pulled to form a shelter. A few very small gourds and some blackened meat hung in the branches, and warm embers told of recent camp fires; but there was nothing else to indicate that people lived there. Not a drum, not a mortar to grind meal, not even an old petrol tin.

Where were the friendly people who had urged us to visit them? The Mbulu laughed when he saw our dismay. He had a sense of the dramatic when he allowed us to examine the village thoroughly and turn back to our cars disappointed. Then he whistled a strange note. With shouts and cries, down out of the trees almost over our heads, dropped the whole population like cocoanuts. And they were pleased as Punch at our surprise.

Over and over again we had to shake hands with all and renew our examination of each and every tree home. We were offered berries to eat, and they proudly showed us their camp fires as if they were remarkable. But indeed it was all they had, so why not be proud of it. Without worldly possession, they were like the Congo Pygmies, just happy hunters and food gatherers.

Each family—wife, husband, and unmarried children—occupied one shelter. This branch of the tribe was composed of Iyaidi's own family, totaling 63 adults. Each village is the same—a paternal headman, his family and relatives.

Hours after our visit, we realized that at no time had we ever seen what might be known as the young virgins of the tribe. And we never did. "Not permitted," said the Mbulu.

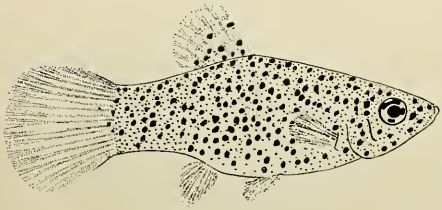
Day after day followed. We loved this spot, far

Continued on page 107

JUNGLE

By Myron Gordon
Fellow, John Simon Guggenheim Memorial Foundation

(Above) Citified fish: *Though their ancestors were born in jungle pools, these specimens were bred in the scientific laboratories at Cornell University. Aquarists have long admired the bright color patterns of the tiny platyfish, unaware that lurking in some of them were clues to the development of lethal tumor cells*



These *fish are now residing at the New York Aquarium and*

Since its discovery in the hidden recesses of Mexico's jungle state of Oaxaca, the tiny wild platyfish has avoided the encircling seines of collectors fairly successfully. Yet these elusive toy-sized creatures are not entirely unknown; practically every armchair naturalist who has ever had an aquarium in his parlor has probably maintained a pair of them. These, of course, are the domesticated varieties, as colorful as the flowers in a cultivated rose garden. But only a few men have been privileged to study them in their natural habitat in the 70-odd years since the French explorer, M. Sallé, found them "somewhere in Mexico."

Today, the platyfish is in the limelight of science. From the tanks of those who lobby for their aquarium hobby, the platyfish has been taken into the inner sanctums of zoological and medical laboratories. It seems that the small aquarium is to be as much a part of the standard equipment of a biological research laboratory as the mouse and rat cage.

These thumbnail editions of fish life are being studied for the light they may throw upon the origin of such devastating diseases as cancer and tuberculosis. Yes, the platyfish, in common with other species of fishes, suffers from cancer-like tumors. This has been known definitely since 1928, and recently Dr. Andrew Baker of the State Veterinary College at Cornell University has discovered an acid-fast bacterium that causes injurious tuberculous lesions in the skin of the body and mouth of the platyfish.

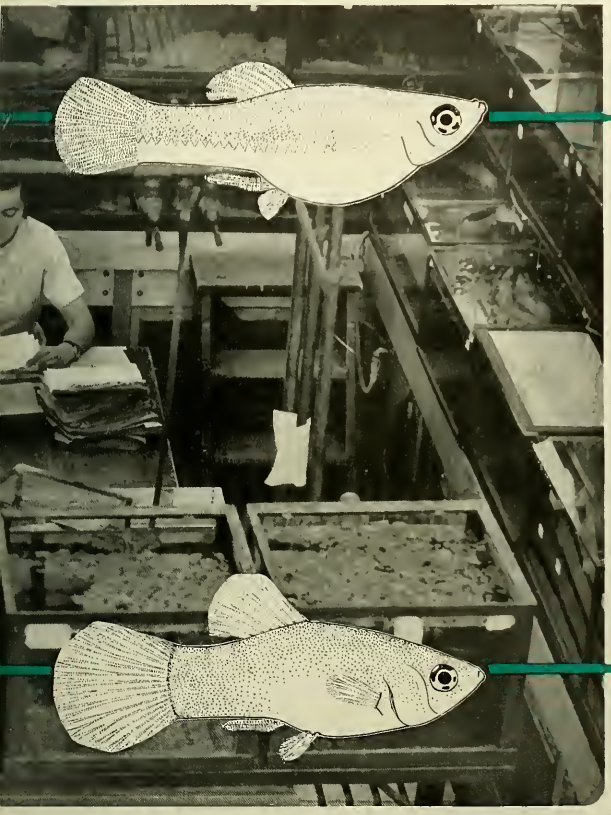
At the Yale Medical School Laboratories, research workers have discovered that peculiar pigmented patches develop in baby platyfish hybrids which gradually grow into large, black, swollen tumors. The pathologists have found from microscopic examination that the cells which produce the fish tumors resemble the cells of a vicious kind of cancer that affects man, melano-sarcoma.

The telltale marks appear in the fish as early as the day of its birth, and scientists hope to find the earliest beginnings of this deadly disease in still younger, embryonic platyfish, so that they may determine the place of origin of the malignant cells that are responsible for this baffling malady, common to all classes of animals. Thus the pet platyfish of the aquarist has become the aquatic guinea pig in the medical world.

Why should some platyfish develop the tumors

BORN AND CITY BRED

Taken from tropical pools in the jungles of southern Mexico, the colorful platyfishes are used in biological laboratories as aquatic guinea pigs in the study of heredity and evolution of diseases such as tuberculosis and cancer



BLACK DEATH *strikes the hybrid, but the pure-bred fish is unaffected. When a healthy black spotted southern platyfish* (far left) *is crossed with an equally healthy unspotted northern species* (upper middle), *the spotted pattern is transformed into the black tumorous disease in the hybrid* (above). *This fish is doomed to die. Microscopically the disease resembles a type of cancerous disease which attacks man*

WHEN THE SAME *fish* (far left) *is mated with an unspotted male of her own species* (lower middle), *her offspring* (below) *are spotted but are perfectly healthy and have never yet developed black tumors. In the wild, platyfish do not breed to produce the diseased offspring because the distinct species live in separate river systems*

American Museum's Laboratories of Experimental Biology (above)

and others not? That was the great question, and a hint of the possible answer lay in the fact that growths are associated with certain patterns or designs.

The color markings of the platyfish are numerous. Zoologists have long suspected that no backboned animal in North America, aside from our domesticated birds and mammals, has a more variable assortment of color schemes and patterns. Without counting the gold, olive-green, red, white, or blue color phases, the platyfish would still hold continental records for variability, for it has a veritable symphony of designs in black. These multimarked fish may show the one, the two or the three dots, that remind one of dominoes. In addition, they may have a beautiful pattern which resembles the crescent of the moon; another pattern appears like the streaks of a comet's tail. The golden black-banded platy recalls the darkness of a miniature sun in eclipse, while the black-spotted one is dotted like a photographic negative of the stars studding the Milky Way. We now know that certain of these designs are the sure signals of fatal tumors.

Scientists have speculated long concerning the causes for this fish's extreme variability in color markings. Some claim that the designs camouflage the animal and thus protect it from its predators. Others suggest that the multiplicity of patterns may express a state of active evolution toward the distinct new types of fish. They point out that an accumulation of these slight changes, if sufficiently diverse, may bring about, over a long period of time, what we call a new species. As one studies these changes, they say, one is watching the process of evolution.

Some patterns were associated with the growth of

THE VALUE *of the platyfish as an aquarium guinea pig led the author to search for native Mexican specimens in 1930. The scene at left, photographed at dawn near the foothills of Mount Orizaba, shows a section of the Continental Divide between Mexico City and Vera Cruz*

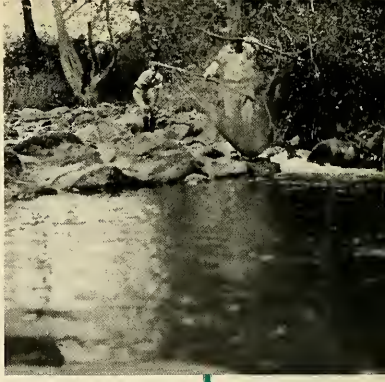
(Below) THE HIGHWAY *to Vera Cruz, in 1930. The following elements of this scene are most typical of the Mexican landscape:* (left to right) *mesquite tree, nopal cactus, maguey, bayonet tree, horsemen, and hacienda*

(Right) BROAD MOUTH *of the Rio Papaloapan at Alvaredo. Although luxuriant tropical splendors were enjoyed, Myron Gordon and his party did not reach their objective in 1930 when they traveled the tortuous course of this river on their first attempt to reach the home of the platyfishes, 150 miles upstream*

(Above) WHERE *thirteen platyfish were found back in 1867: Rio Papaloapan at Cosamaloapan. Constant threat of floods during the torrential rainy season induces the inhabitants to build their huts on stilts. When in 1930 the scientists were ready for their platyfish hunt here, the rains came and "washed out" their expedition. They determined to return*

(Right) A TROPICAL LAGOON *near the village of Papaloapan, visited in 1932. The place was teeming with fishes, which were constantly breaking the surface either to bring down a fallen insect or to get a breath of fresh air in this stagnant water. Despite the large number of fishes, the platyfish were not found in the large lagoons. The cormorants in the background, kingfishers, herons and egrets competed with the fishermen for the spoils. These lagoons are the beds of former river courses and are connected with the rivers in the rainy season*

(Right) SAND BARS *cut across the free flow of Rio Papaloapan at time of the dry season. Here a banana barge has become grounded. River men jump out and push her off into deeper water. Traveling up the Rio Papaloapan three miles by smaller boat, the scientists reached the mouth of the Rio Tonto, and from one of the smaller tributaries, they found in 1932, 101 specimens that had 40 different color patterns*



FOUR SPECIES OF PLATYFISH

(Left) THE HOME *of the northernmost platyfish, and below, the fish* (P. couchianus). *It lives in the spring runs of the Rio Santa Catarina, ten miles from Monterrey*

(Right) "THE SWORDTAIL *platy" is the meaning of its scientific name,* P. xiphidium. *It is being taken here by minnow seine wielded by Dr. Myron Gordon, in one of the tributaries of the Rio Soto la Marina*

(Left) VARIATUS *platyfish is what scientists and aquarists call this platy from the tributaries of the Rio Panuco. The scene is at the ranch of Doctor Ostos near Tantoyuca, Vera Cruz*

(Right) THE "PLATYFISH JACK POT" *was hit in 1939 when over 8000 platies were taken from pools like this in the Rio Papaloapan area. Black spotted members of this species* (P. maculatus) *produce the tumorous disease when crossed as explained*

tumors and some were not; and many patterns might have resulted from crossbreeding during the fish's long domestication. Therefore, when confronted with the laboratory histories of the tumorous platyfish, the members of the medical profession wanted to know whether similar pathological cases occurred among the wild fishes. The answer to this question proved to be most exciting, but in a direction that had hardly been expected.

Up to 1932, the total number of wild platyfish deposited in the various museums of the world stood at 83, hardly enough to provide a serious conclusion. Only three men had previously taken them from their native pools and rivulets of the Papaloapan River valley. Exactly where and when Sallé found the first two specimens of platyfish, no one knows. The time must have been before 1866 because in this year the Curator of Fishes at the British Museum, Albert Gunther, gave the platy its technical name, *Platypoecilus maculatus*. He must have been thinking of a "broad, little fish with a variegated pattern," for that is what the name means. Some say that this tongue-twisting label is much too long for so small a fish, but curiously the name, in print, just measures the length of a fully grown platy. Be that as it may, American aquarists chopped that learned title down to the first two syllables. To them, the fish's moniker is just platy.

The second collector was Dr. Francis Sumichrast, who was sent down to old Mexico in 1867 on a collecting trip for the then budding Smithsonian Institution of Washington. On one of his expeditions he picked up thirteen beautifully marked specimens from the Rio Papaloapan near the sun-stupored village of Cosamaloapan.

Then after a long lapse, the Field Museum's ichthyologist, Seth E. Meek, in 1902 collected 68 platyfish at El Hule on the Rio Papaloapan. His catch fascinated him, for he had 26 different patterns. He studied them carefully and came to the conclusion that they were the most variable in color markings of all the fishes he had ever seen, and Meek had seen plenty in his lifetime.

With the growth of the hobby of keeping small, colorful fishes from the tropics in the home, particularly in Germany, sailors from ships out of Hamburg and Bremenhaven were commissioned to bring back living specimens from tropical ports of call. In the *Wochenschrift für Aquarien und Terrarienkunde* Herr Georg Gerlach reported the safe arrival of platyfish in 1907 and their successful culture in 1909. From German aquaria where they multiplied rapidly, they were sent around the world. American aquarists, north of the Rio Grande, got their first platyfish, not from their next-door neighbor, Mexico, but from Germany in about 1910. And all the time the world was ignorant of the important medical story these fish had to tell.

After a few years under the watchful eyes of keen fish breeders, a number of colorful varieties were established. Some enterprising aquarist even discovered that platies would hybridize with the Mexican swordtails, and this act of miscegenation led to the creation of a still greater assortment of types both in body styles and bizarre color schemes.

By the 1920's when the platies were taken into the laboratory for a complete biological examination, the doctors did not know whether they were testing a pure species or a mixture. Even so, they revealed beyond doubt that these little fishes were eminently suitable for biological studies in heredity, in sex determination, in development of social organization, and in the evolution of tumorous diseases. Their habit of bearing their young alive has made possible studies of the nutritional and respiratory relationships between mother and young during the period before birth. Through these and other studies, scientists realize more and more, that while the distance between fish and man is great, both groups have traveled over many similar paths in the past.

And then came the really amazing discovery—a discovery whose importance only the future can tell —that a very simple explanation accounts for the fact that some platies get the tumors and some do not. Those which get them are all hybrids, that is, offspring of two different species. Pure-bred platies never do. This brings us to our recent platy-hunting expeditions to Mexico to learn more about the wild platy. Biologists wanted to check the behavior of the domesticated strains against those living under natural conditions. The National Research Council, the patron of many scientific projects, provided some of the funds for the first expedition in 1930, and the Museum of Zoology of the University of Michigan added a part. The party consisted of Edward Creaser, Ricardo Ostos, and the author.

In May of 1930 we innocently approached the platyfish country from the Atlantic. We hired a small motor launch and three river men at Alvarado, about 20 miles south of the city of Vera Cruz, and sailed up the ocean-like mouth of the Rio Papaloapan. As we crept slowly into the gradually narrowing stream, huge flocks of mud hens splashed and cavorted along the rush-bordered river. Rafts of water hyacinths floated down in island-like masses. Everything we had expected in a tropical paradise was there. We enjoyed the trip, but it was a failure, for we could not reach the platyfish country in time. Three factors worked against us. First, the river current was strong and our motor was weak. For every mile we

gained in a straight line, we were forced to cover three; the meanderings of the river, when projected on a map, seemed to follow the contours of a pretzel. Finally, when we reached Cosamaloapan, the site of Doctor Sumichrast's platyfish discovery 60 years before, the rains came and "washed out" the venture.

The great business depression did not destroy but stimulated the keeping and breeding of tropical fishes, bringing a new all-time popularity high for the number of aquarium societies, tropical fish dealers, and aquarium magazines. From funds advanced by aquarists who wanted new varieties from Mexico, we got our second chance to explore the Papaloapan in the early spring of 1932.

No more slow river boats for us, we decided, in making our plans to reach the upper portions of the Papaloapan. This time, with John Ross and Joe Whetzel, we traveled the fast way, comparatively speaking, by train from Vera Cruz. My brief case, full of letters of introduction to the military and civil authorities of Vera Cruz, contained a message to the superintendent of the Standard Fruit Company at Papaloapan, Oaxaca. This proved to be particularly effective. The Company offices and plantations are located on the Oaxacan side of the Rio Papaloapan in the heart of the platyfish country, a spot on the river exactly where, 30 years before, Seth Meek had caught 68 platyfish.

Every facility of the Company was placed at our disposal: guides, saddle horses, motor cars, and launches for our fishing sallies. In the Company dormitories we enjoyed three meals a day, fine beds, and the benefits of a shower bath. After ten days of camping and driving by automobile over 1,000 miles on that hot, dry, dusty, alkali desert from Laredo, Texas, to Mexico City and then over the mountains to Vera Cruz, thence by train to Papaloapan, the perfect service and comfort of our headquarters meant more to us than a paid-up, de luxe suite of rooms at Sun Valley Lodge.

We spent a day in getting ideas concerning the lay of the land and water. To the southwest, at sunset, a golden, red glow fringed the peaks of the Oaxacan mountains. Rushing down from their foothills, the waters of the Rio Tonto sweep swiftly in a narrow valley until they enter the much wider river valley of the Papaloapan. Both banks of the Tonto are precipitous; the rushing waters, having established their course, are prevented, for the most part, from further encroachments upon the land owing to the dense growth of trees, brush, entangling vines and creepers that fringe the shores. Downstream, a mile or two north of the junction, the character of the shores is determined by the wide sweep of the Rio Papaloapan. Unlike the Tonto, which fills its river bed completely, even during the dry season, the Papaloapan runs in a restricted channel with wide stretches of beach covering much of the exposed river bed. Inland, the area is given over widely to the cultivation of bananas; and the plantations extend right down to the river banks. This intensive cultivation has brought about the destruction of the natural jungle-like cover, the protective vegetational barricade against the eroding force of the river.

As the dry season advances, great sand bars appear that hinder the even flow of the stream. River boats follow the path of deep water that runs alternately on one side and then on the other. Huge losses of land along the cut-in slopes, freshly fallen into the river bed, testify to the ever increasing demands of the water for easier paths to the sea. At the height of the rainy season these short cuts are insufficient, and the waters spill over their banks. They inundate large shallow areas and hollows far back from the river. For this reason the Company buildings and the native huts are built upon stilts at least five feet high. When the rains come, the roads become obliterated; the main and only permanent street in our town, Papaloapan, is the highly banked railroad track.

From the junction of the Tonto with the Papaloapan to the sea, a distance of about 100 miles, the land is studded with lagoons. The larger ones are undoubtedly the old river beds of former times. Many of them lie in a chain-like series and are connected by rivulets for the greater part of the year.

Just back of the Company buildings lies one of the long, scum-covered lagoons. The place was teeming with fish. Cormorants were perched on abandoned piles, their long crooked necks balanced awkwardly over their equally long bodies. Pint-sized kingfishers teetered back and forth on the low branches of trees that overhung the lagoon. Long stilt-legged herons waded along the shoal water areas. This, truly, was the birds' domain. Fishes were constantly breaking the surface of the yellow water, some to bring down a fallen insect but most of them for a breath of air, for the dry season was well advanced and the lagoon water was charged with decomposing organic matter.

Long ago we had lost our squeamishness about wading into and spreading the seine in uninviting waters, but it required extra courage this day as we slid down the slippery filth-strewn banks. We might have collected a ton of small fishes, but we were convinced, after fishing a short time, that the lagoon contained only a few species notwithstanding the great number of individuals. After taking a measure of the fish population, we had red-finned characins, red-throated ciclids, mud-colored rhamdid catfish, huge orange-finned mollies, and a mess of diseased dormitators—we lost interest in fishing any longer, particularly

when we realized that we were not to get our platyfish here. We left the rest of the fish population to the cormorants, kingfishers, and herons. Their loud and raucous cries quieted as we departed.

On succeeding days we fished in other sections of the Santa Rosa Lagoon and in the Santa Ilena. The story was the same: lots of fish, but no platyfish. The smaller inland pools were dry. When we were quite discouraged, Bartolomo and his motorboat came into our lives. Bartolomo was a dark-skinned, pure Mexican Indian who had a sinister look with his long, coal-black mustachios and a broken wide-brimmed sombrero. He was, actually, the kindest of men. He listened to our requests and headed for the Rio Tonto.

Newspaper headlines flashed the success of that trip. To be sure it did not rate a front page, but it did have a note of novelty. As the story was taken up by rewrite men on other newspapers, the novelty grew. The *Syracuse American*, for instance, dramatized the news in these heads:

"Cornell Men Enter Jungles After Quarry

"Tropical Pools of Southern Mexico Yield Fish to Be Used in Their Experiments

"Three Members of Party Go 4,000 Miles to Set Nets in Branches of Rio Tonto

"Ithaca, April 23.—Deep in the jungle recesses of the Mexican State of Oaxaca, three men knelt beside the bank of a swift current of a rivulet which pours its water into the Rio Tonto.

"Suddenly one of them, clutching a tiny fish in hand, leaped excitedly to his feet with a shout.

"Thus 4,000 miles from this city, from which they departed two months ago, did a Cornell party of scientists find the fish specimen which may have a vital influence on the future course of medicine."

The creek was not swiftly flowing but was merely a series of disconnected pools. The banks were heavily covered over by an entangling mass of vegetation. We had to hack our way through the brush and overhanging vines with machetes. Our first haul in the pool nearest the Rio Tonto brought to light a beautiful series of platyfish. We worked every pool for about a quarter of a mile, but the farther inland we went, the fewer fishes we found and so we concentrated on the more productive pool.

Before that day and the next were over, we had taken 101 platyfish, the most striking feature about them being that they were marked in 40 different ways. We recognized patterns that were also represented in Doctors Sumichrast's (1867) and Meek's (1902) catches.

Try as we might, we could not find any more platyfish in this or any other locality. The rainy season was soon to start so we left the Papaloapan River Valley to finish our work to the north, collecting many new forms for the aquarists.

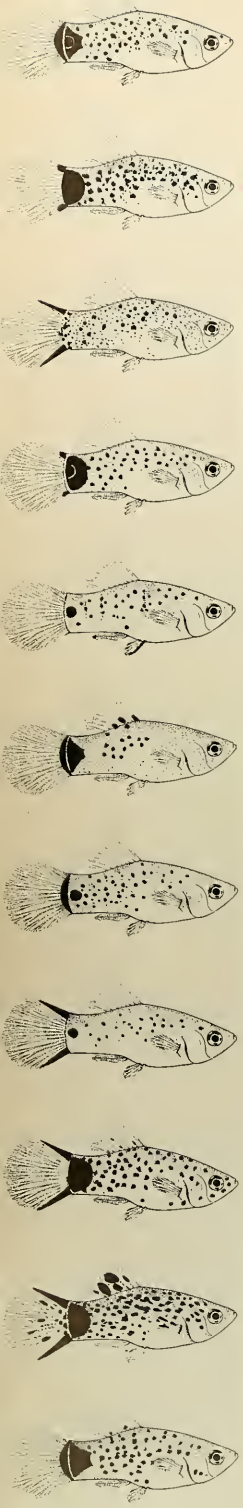
Our work in Mexico's Papaloapan was not yet done. After all we had spent but a week there, just long enough to appreciate its possibilities. Even as we turned back in 1932, I planned, at some future time, to return to spend a month in exploring it earlier in the dry season and to study the life in the pools just before they dried up. Too, we needed further data for a book on the fresh-water fishes of northeastern Mexico, which is being prepared at the University of Michigan by Dr. C. L. Hubbs and the writer. The opportunity to do these tasks and to replenish our stocks came in 1939, thanks to the generosity of the John Simon Guggenheim Memorial Foundation.

We arrived in Papaloapan in early February. Again we were the appreciative guests of the Standard Fruit Company; again the many courtesies were granted to our party which this time consisted of James Atz of the New York Aquarium, my wife, Evelyn, and me.

After settling down to work, our first request, naturally, was to be taken up the Rio Tonto to the rivulet where, seven years before, we had caught a hundred platies. The river man who brought the launch to the bench looked strangely familiar. It was Bartolomo, but minus his magnificent mustachios. A serious facial operation had forced him to part with them. After handshaking all around we started off. He had lost none of his skill in maneuvering his craft through the meandering river deeps; within an hour we were back in the Tonto and soon were anchored at the mouth of the same rivulet.

Jimmy and I clambered up the gully wall and worked inland. We searched for the shallow pools within the stream bed, but all was changed. This was February, and the arroyo had not yet begun to run dry: all the deep holes, later to become pools, were brimful of water and cluttered with formidable snags of fallen trees and broken branches of spiny shrubs. We tried a few hauls, working neck-deep in water, but the fish were as safe from us as if they had built themselves barbwire entanglements. We came home despondent, with but two platies to add to our collection.

Day after day for the next week, we went out looking for platyfish. We visited and fished lagoons and small streams in every direction out of Papaloapan. We continued to catch a platy or two a day but that was hardly enough for our purposes. Again a member of the Standard Fruit Company came to our rescue. Señor Ramón Ibarra, auditor by profession, hunter



PATTERNS OF DISEASE. *The fish on the left-hand page show large black spots on their sides. When they are crossed with another species, the offspring will be sure to develop black tumors*

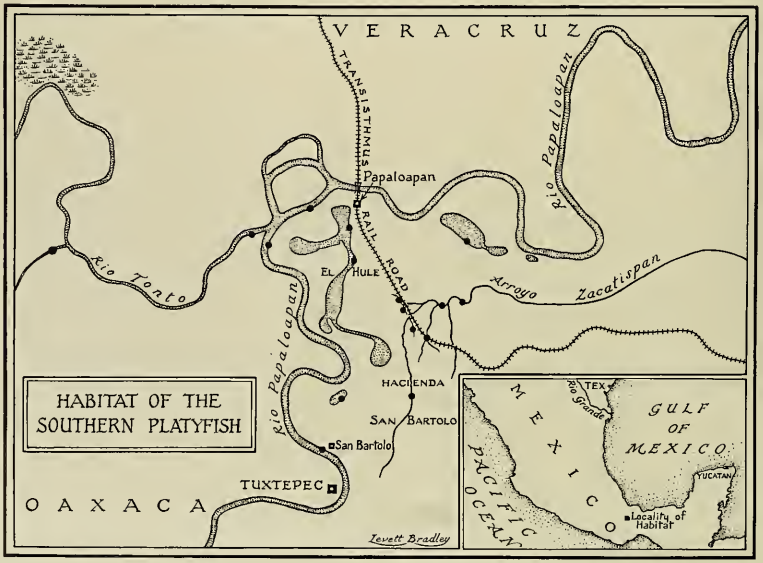
DEATH *of a pond is shown in this series of photographs. The explorers . . . .*

hastened their work as the water in these pools evaporated, knowing that not until spring . . . .

and fisherman by nature, took us in hand. His knowledge of Papaloapan and vicinity was gained by long tramps with a rifle at his side, hunting for doves, ducks, and woodcock.

We showed him the platies we wanted. *Si, si,* he had indeed seen these *topotos* and tomorrow he would take us to the spot but today, Sunday, if we would be so kind as to be his guests, he would like to take us out fishing for real game, not *los chiquitos* but *los grandes,* 100-pound tarpon, chunky robalos, and the sportive jacks. Ibarra told us that his friend, Staalgaard, and he had caught a seven-foot tarpon in the Tonto and he supported his claim with a tarpon scale that was larger than a silver dollar. This was fishing news of prime importance, for no tarpon had ever been reported such a great distance up this stream, in pure, fresh, rapidly flowing water 100 miles from the sea. We gladly postponed platy fishing for the morrow. We found his story true, for Jimmy got a big tarpon on his hook and Señor Ibarra brought in a huge robalo.

Next day Señor Ibarra quit his office work at four, and we set out for the headwaters of the Arroyo Zacatispan. Saddle horses were provided for the four of us and we rode through jungle land and low spiny shrub country until we arrived at the Zacatispan, a narrow, deep arroyo hemmed in by overhanging vegetation. This was not an ideal place for seining operations but Jimmy and I went to work. For two solid hours we walked, lunged, and stumbled through that



SIDES UNSPOTTED. *Platyfish on this page may be bred to another species without fear of disease. Geneticists are investigating whether these tiny fish may explain the rôle of inheritance in cancerous disease*

would the inland platyfish homes be repopulated by inrushing waters from the main stream . . . .

of the Rio Papaloapan. Remaining aquatic inhabitants were snapped up by the ever-ravenous birds

stream trying to encircle those elusive platyfish, and for our efforts we had but a beggarly half-dozen. Our disappointment in our platyfish hunting was somewhat assuaged by finding a new Rivulus killifish, a rare Symbranchid eel, and the long-sought-for black-spotted swordtail.

Señor Ibarra insisted that platyfish were in the vicinity and suggested we try another section of the Zacatispan farther upstream. We trudged wearily through the entangling vegetation to where our horses were tethered. Dripping wet as we were, we climbed into the saddles, a little despondent. Our guide was not, at the moment, any happier than we. While Jimmy and I were seining the Zacatispan, he had moved about the country looking for wild doves. He had been tipped off by some of the agrarians that *las palomas* were here. All he got for his thorn scratches was a beautiful collection of *pinolejos*. In case you do not know what *pinolejos* are, let me explain that these tiny, brown, mite-like parasites are the scourge of the underbrush. Ibarra's legs and arms were alive with them; he looked as if someone had dusted him with a thick layer of paprika. We got some of the chiggers, too, but not many, since we were in the water for the most part. Nobody can walk a step in this chaparral country without picking up a generous allotment of these clinging, blood-sucking pests.

Taking a moment out to whip his trousers and sleeves with a pliant twig to dislodge these *pinolejos*, Señor Ibarra led the party forward. In short order we came to a point where a branch of the Zacatispan formed a wide and shallow swamp-like area. We dismounted, tied our ponies to clumps of thorny mesquite, and immediately started our seining operations. We chose a spot which was relatively clear of weeds and where the water was about two feet deep. We first covered the clear area and then headed into the aquatic vegetation. We pushed the seine deep into the weeds and then hauled in. The platies were there, *en masse!* Our seine held 30 of them glistening in the sun. The rest is a success story; we had hit the platyfish jack pot!

In a half-hour we got more than we had taken in the previous week. The locality was readily identified on the map because the main line of the Transisthmian Railroad runs close by. Kilometer markers indicate the distance from Cordova to Suchiate. The platies were caught near the 149 kilometer post. For the next three weeks our hunting cry was *Vamanos a kilometro un ciento, quarenta y nueve!*

Within this area we collected in one month over 8000 platies, whereas only 200 had been taken over the past 70 years by all previous expeditions. Lest those of you who feel that we went too far in our enthusiasm and had taken not only stock but seed as well, let me hurriedly add that the water in the shallow ponds was rapidly evaporating. Indeed, when the water level fell to four inches, the birds moved in for holiday picking, and we witnessed the extinction of several bodies of water and their aquatic animal population: fish, amphibians, and insects. The platyfish and other life in these isolated units are doomed to die. The pools will be repopulated from the permanent stock in the main river, the Papaloapan, next season.

While we were busily seining in our aquatic bonanza, we caught sight of a few brilliantly colored platyfish, but it was only when we got them home that we really began to appreciate our find. The wealth of platyfish types was incredible: there were 125 different patterns in black markings alone. Practically every form seen in the home aquarium was present except the white, golden, and the all-red varieties. Some had brilliant red dorsal fins and others had blazing red bottoms that reminded me of baboons in the Mexico City Zoo. But for the most part, the platies were subdued in coloration.

We had several new patterns, which, as far as I am aware, have never been introduced into aquarium stocks before. One is the beautiful comet, with a dark line on the upper and lower margin of the tail; another is the single crescent. Striking combinations of patterns are shown, one of the most pleasing being the crescent and the comet; another is the crescent-

star, one in which a small black spot lies within the crescent like the symbol of the ancient Turks.

We found no cancerous growths among the wild platies, but we knew from the previous work in the laboratory that in every black-spotted platyfish there lies the potential factor that, when transmitted to their hybrid offspring, will produce the cancerous state. These individuals were particularly valuable for our experiments.

After several disheartening attempts to ship the wild platies 2000 miles north to New Orleans and thence 2000 miles more to our New York laboratories, we finally succeeded. At this moment they are swimming about in tanks at the New York Aquarium and at the Laboratory for Experimental Biology of the American Museum of Natural History.

Geneticists, fortified with long mathematical formuli, are working over the mass of data on 8000 platyfish. They are trying to find clues in the 125 wild patterns to the possible part played by small, heritable characters in the evolution of species.

Here in their New York City apartments, the platies from the jungles of Oaxaca have met their northern Mexican relatives for the first time. Platyfishes from the states of Oaxaca, San Luis Potosi, Tamaulipas, and Nuevo Leon are here united to grace the parlors of amateur aquarists and to advance our knowledge of living organisms from fish to man.

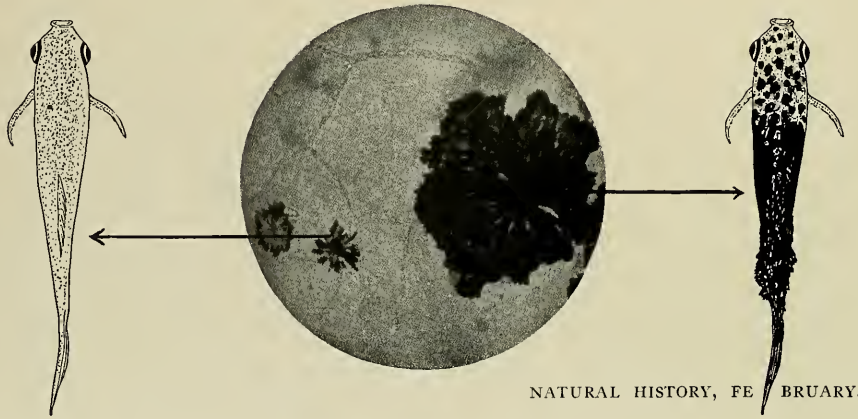
In our laboratories we have mated two tumor-free fishes and have successfully predicted the proportion and sex of offspring that will die of the disease. Take the case of the normal black-spotted platy from the Rio Papaloapan. Mated with a different species from some other river, a black-spotted mother fish will produce spotted sons all of which will develop tumors, while all her daughters will be normal. This mother-to-son type of inheritance, geneticists call sex-linked. If the same spotted mother had been mated to an unspotted male *of her own species,* she would have given birth to normal spotted sons and normal unspotted daughters.

We cannot apply this rule to man. Many medical men are not convinced that cancerous diseases are heritable in human beings and life insurance companies do not increase their rate for persons born of cancerous parents. With debate over the heritability of cancer in man in progress today, it is impossible to predict the importance of the fact that cancer-like growths in the platyfish are known to follow inherited body patterns.

It is not the purpose of biological investigators to try to find cures for these fishes and then to apply similar remedies to humans. Rather they search for the clue to the evolution and the development of these universal diseases as they express themselves in the lower animals like fishes, frogs, snakes, birds and, finally, in the mammals, which include man. Fish, being at the foot of the vertebrate animal ladder, are of particular importance, for in them the most primitive conditions of the diseases may exist. It is probably safe to say that fishes had cancerous diseases long before man.

SMALL BLACK *pigmented cells, when they appear in a hybrid fish, behave in a normal manner and the fish is not diseased*

LARGE BLACK *pigmented cells, when they appear in a hybrid fish, grow out of bounds and eventually produce a black tumor*



Continued from page 95

from the other world with only our wild men for companions. But one morning we had a short, sharp shower. We knew that it meant we must not linger or we should be caught in the sticky, black cotton soil for perhaps weeks, even months.

Hurriedly we asked a last favor of Iyaidi. We would like an *ngoma* (dance) for our pictures. Iyaidi agreed and chose a fine open place at the foot of an enormous kopje, flanked on two sides by thick thorn bushes and the big trees at the river's edge, with Lake Eyassi glistening in the sun.

What a picture it was! Black gleaming figures threw fantastic shadows against the rocks as they chanted a monotonous tribal song. Women with babes on their backs steadily hopped from straight line to circle, back to straight line; small children enthusiastically crooked the knee, leaped and hopped with shouts of joy, while the men, with heads thrown back and hypnotic ecstasy on their faces, followed a series of intricate steps in perfect rhythm with unceasing chant, varying the dance with loud shouts as they extended their arms high into the air. A delightful incident was provided, as you see in one of the photographs, by a small boy, no more than four, who danced with his elders, keeping perfect step in all the various movements. It was not the spontaneous exhibition often given by other tribes—no one did a solo of wiggly gymnastics—but it was a good show and we ground out foot after foot of good colored film.

Then came the time to bargain for the few possessions they had. Out came the tinsel ribbon, and ten-cent jewelry brought from America for the purpose, and knives, blankets, and tobacco. It was hard to get Iyaidi's pet skin bag that he always wore slung over one shoulder, but we did. He was in the act of emptying it when I. H. stopped him. It was the junk in it we wanted most of all. So we possess the smelliest bag in creation, which contains "good luck" hair of certain animals, tobacco, snuff of native make, little stones that are charms against bad luck, a few herbs, medicine for his stomach, and the communal stone pipe.

Jewelry brought me, the Memsahib, only smiles and good will, for the women had nothing but the messy skin skirts they wore. The ornaments seen in the picture are presents from us. They refused to part with the fine beaded bands that they wore on their heads, and we hardly cared, for as nearly as we could discover, they were rewards for some sort of favor done the Mbulus and were exactly like those belonging to the latter.

The proper celebration for our farewell was then up to us. And so it happened that just after the *ngoma* was over, we came upon a very large rhino near the lake, which I shot.

The men made a grand business of disemboweling the creature, saving each trailing innard for some purpose unknown to me. It was a busy time, and we "girls" sat at a respectful distance away from the lords and masters at work, who came every now and then to throw over a wife's head a fine juicy garland of raw, red rhino. Each hunk was cut into long, thin strips so that the happy wife might more easily carry her prize the many miles home. It was a sight to watch a wife weaving strands of the bloody stuff around her neck while baby nursed. If baby became intrigued and forgot its lunch, mother simply yanked it back to its milk.

Several hours passed in this fashion, and we whiled them away very comfortably, smoking and coughing together and smiling broadly at one another.

Morning brought another shower, and we hastened to break camp at once. Strange to say, Iyaidi and Sagasi failed to pay their daily visit for the first time. We had not said that we were leaving that day. They knew it would be soon, but we had set no time ourselves, biding the rain. They did not come at all, though we watched hopefully for a chance to say good-by. As we made our heavy way with overloaded lorries, we heard from far down the river a familiar call and shrill laughter from the other side of the stream. We stopped the cars, and ran to the water's edge calling, "Iyaidi! Sagasi!" There was a dead silence. The Mbulu whistled; we called again. No answer.

Like the Pygmies, I suppose, the Wa-Kindigas are a carefree, unremembering lot. We had served a good feast for many days, but they didn't need white people to make them happy.

ADVENTURES WITH

A CURIOUS BIRD is the spoonbill. This one, sensing something unfamiliar, came so close to the camouflaged camera in his investigations that his head filled the entire glass. *Ajaia ajaja* to scientists and "pink curlews" to natives of Florida, this precious rarity reigns supreme on his own small island in the Florida Keys. Scarcely 100 breeding birds remain here of this once numerous clan

THE ROSEATE SPOONBILL

By Karl H. Maslowski
and Peter Koch

Photographs by the authors

[Photography is wisely prohibited on tiny Bottle Key in the Florida Keys, where one of the oddest and most beautiful birds in North America is being given every chance to win the struggle for survival. The accompanying pictures therefore present a subject rarely viewed. By special permission the authors, as members of the Charles F. Williams Expedition of the Cincinnati Society of Natural History, were allowed to photograph these birds by the National Association of Audubon Societies.]

Long necks *outstretched, these spoonbills splash pink daubs against the blue sky. In flight their position is more streamlined than that of the herons, whose necks fold into an S curve. Spoonbills are also found on the Texas coast*

Our physical exertions as we fairly battered our way across Bottle Key would have been the acme of hardships under normal conditions. Mangroves whose branches were interlaced like the reeds of a bird cage and insectean pests of half a dozen kinds impeded our progress, but they only added to our impatience and zeal to get to the other side of the island.

Since boyhood we had been waiting for the moment when we might feast our eyes on one of the oddest and rarest birds of eastern North America—the roseate spoonbill. Now that scarcely 200 yards separated us from one of the favorite feeding sites of the few remaining spoonbills in Florida we felt as though we were on the threshold of an avian fairyland instead of in the depths of a well-nigh impenetrable mangrove key.

Squirming and crawling with our load of cameras, we at last glimpsed open water ahead. Using as much caution as possible, we advanced to the outer fringe of the mangroves and peered through their heavy salt-crusted leaves. Thirty yards away a little blue heron stalked about with a seriousness all out of proportion to its size. Farther offshore three bright-billed royal terns hovered over the shallows. Roseate spoonbills—the birds we had come so far to see—were nowhere in evidence.

Earlier that same day Claude Lowe, the Audubon warden for this area, had assured us that roseate spoonbills came regularly to feed in the shallow waters which we now surveyed. If so, we determined that although it should require our spending our entire Florida vacation on this spot, we would make pictures and observations of "pink curlews," as the native Floridian is wont to call *Ajaia ajaja* (pronounced Ajay′-ya ah-yah′-yah). Accordingly we concealed ourselves in tiny mangrove clumps which grew some 30 yards off the shore of the key, and started our wait.

The island before us known as Bottle Key, six miles by water northwest of Tavenier, is one of the few remaining, if not the very last, stronghold of the roseate spoonbills in Florida. In a state where once this magnificent bird flourished by the thousands, it now battles extermination with thinned ranks that number scarcely a hundred breeding birds.

Were this not our freshman year in Florida the mangrove roots on which we were sitting in our natural blinds would in time have driven us to distraction with the uncomfortable feeling of resting on nothing less sharp than a guillotine blade. As it was we had but to turn our heads slightly from sight to sight to be greeted on every side by something new. At our backs brown pelicans were constantly plunging violently into the shallow waters for food; on a mud flat, visible from our station, we could see thousands of fiddler crabs waving their one long claw as though beckoning us to come over to visit; high overhead 30 man-o-war birds glided effortlessly in great wide circles.

Then our observations were abruptly cut short by a rustle of wings. We glanced up and there planing down were spoonbills and more spoonbills. In an instant 43 birds had alighted in the water before us, all within 20 yards of our hiding places!

For a long moment the entire flock stood statue-still except for the occasional movement of a bird as it turned its neck from side to side peering into the nearby vegetation as though searching for possible enemies. The sight of the 43 spoonbills against a background of dark mangrove leaves will remain forever one of our choice ornithological memories. They looked like a necklace of pink and ruby-colored gems in a jeweler's display box of emerald-colored velvet.

Fully two-thirds of the birds before us were immature. Lacking in their plumage was the lovely carmine and buffy color of the dozen or so adults. Instead they were clothed in a more modest dress of pale pink and white feathers. The young birds, too, were readily separated from their parents by the fact that their heads and throats were fully feathered, not naked.

One thing that both the young and adults had in common was a bill which is unique among the birds of the United States. Their weird appearance and name are both the result of this strange prow. Flat, six and a half inches in length, and yellow-brown in color, this bill looks for all the world like an enlarged wooden spatula of the kind with which one spreads mustard on a picnic hotdog.

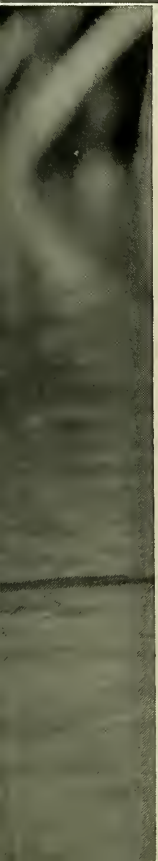
The spoonbills soon showed us what use they made of these strange appendages, for suddenly the whole flock lowered their bills into the water, and moving forward at a rapid pace swung their heads from side to side with the mandibles working rapidly, searching for food. In this process the head was immersed at times almost up to the eyes in water at about a 45° angle and swung from side to side in an arc of 24 to 30 inches. After perhaps half a dozen or so of these swings the head would be lifted and the bird would stand working its mandibles like the jaws of a contented cow munching its cud in the cool shade of a pasture tree. Then the walking and feeding would be resumed.

We marveled at the ability of the spoonbills to walk about in the underlying mud of the shallow water. This mud looked like wet plaster and was composed of the millions of skeletons of tiny sea creatures. It looked as though it might be easy to walk on, but in crossing to our hiding place it was all we could do to keep from becoming bogged. As we struggled to free one foot the other would sink so deep that at times we almost despaired of extracting our-

YOUNGSTER: *at the ripe old age of 3 years, he will lose his head and throat feathers, become a bald adult. His plumage will change from pink and white to carmine and buff*

(Right) FEEDING *is a large scale operation with the spoonbill. Plunging his broad, spatula-shaped bill into the water, he moves forward rapidly, swinging his head in a wide arc from side to side. A dozen swings fill the open beak with plant material, small fish, aquatic bugs; then he pauses to munch them contentedly*

(Left) ONLY BIRDS *could comfortably wade about like this in the shallows off Bottle Key. The authors tried it and bogged down in the soft ooze composed of many millions of skeletons once the property of tiny sea creatures. Further beset with entangling mangrove branches and nipping insects, the authors held out long enough to take pictures of these rarely photographed birds. They were rewarded with a ringside seat at a fantastic spoonbill fight, wherein two birds clapped their bills and flapped their wings at each other, although little damage was done by either combatant*



selves with anything less than a crane and hoist. The spoonbills experienced none of these difficulties.

Only once could we make certain of an article of food which one of the spoonbills swallowed. This was a small fish, the tail of which projected for an instant from the bill of an immature bird as it stood within 20 feet munching a mouthful of food. Judging by the observations of others, the spoonbills were possibly finding plant material, aquatic bugs, gastropods, shellfish, and shrimp in their underwater probings.

Our camera lenses which were poked through openings in the mangrove leaves caused little concern—rather they instilled the birds with considerable curiosity. On one occasion an immature bird moved to within five feet of our hiding place. So close was the spoonbill that its head more than filled the ground glass, and the telephoto lens with which the camera was armed at the time could not bring the image into sharp focus. The first sound of the spring motor of the movie and the bang of the still camera shutter brought the spoonbills to rigid attention, but they soon lost interest in these sounds.

Twenty minutes after the arrival of the flock, ten of the adult birds sprang into the air and flew eastward beyond our sight over the tops of the mangroves. The others busied themselves for half an hour more, feeding voraciously. Then something most unexpected happened. As we looked through the hood of our still camera we were amazed to find eleven of the birds falling asleep, scarcely 30 feet away. Standing on one leg, the other drawn close up to the body, with eyes closed and the head dropping slightly, they looked weird and exotic indeed. One particular youngster that seemed a little older than the others must have felt his superiority, for he went about disturbing the eleven birds in turn. Finally he came to one spoonbill that resented this disturbance, and there ensued the most comical battle we have ever witnessed. Hopping up and down, and dodging from side to side with wings partly outstretched, they picked at each other with their bills. These they clapped together with a sound not unlike the rattling of dinner plates. This fantastic fight was soon over with the bully the loser, and he beat a hasty retreat.

We learned that the spoonbills were fond of perching in the tops of mangroves and noted that they spent many hours in such situations, resting and apparently enjoying the hot April sunshine. When so perched, they were visible for great distances—their glowing pink color contrasting sharply with the blue skyline and green foliage.

The greatest number of birds we saw at any one time was a flock of 59 "pinks" which flew over just at sundown on our last day's stay at Bottle Key. We saw them from afar, flying with necks and legs stretched out to the fullest in V formation like geese. Their steady wingbeats carried them almost overhead, and as they passed into the incandescence of the sun the bodies shone with a luminous pink glow like the reflected light of some great lamp.

May that glow of this pitiful remnant grow someday to the flame of the thousands of Florida spoonbills of yesteryears!

CONFESSIONS OF A HUNTER

The tragedy of Nature's innocent non-combatants would be prevented by the rule: Know Your Animal Before You Raise Your Gun

By Roy L. Abbott
Professor of Biology, Iowa State Teachers College

The sun was hot that late October afternoon, and my companion and I were sitting half-asleep in our blind waiting for ducks that wouldn't come. In fact we hadn't seen a duck that day. Yet from all around over that great marsh came the steady boom of guns, not in sudden staccatos, but one load at a time—a sure sign of hunters burning their powder just for fun and at anything that happened along. Suddenly my friend gripped my arm and pointed excitedly toward a big gray bird flapping erratically over the water perhaps a hundred paces distant.

"What's that?" he whispered.

"Nothing that you'd care to eat," I said. "But wait a second and I'll bring it over where you can see it better."

Then I quickly placed my lips to the back of my hand and made a sort of sucking sound, somewhat like a kiss. At the slight noise thus produced, the bird whirled instantly and came rapidly in our direction—fell dead, in fact, plump against the blind—for my friend fired before I could stop him.

He was all eyes for his "kill" as I reached over and picked up the smashed bird now hardly more than a lump of ruffled feathers.

"Gosh!" he exclaimed, "I sure socked him! What is it, an' how'd you manage to toll him over?"

"Short-eared or marsh owl," I said disgustedly, but trying not to show it. "Ears like microphones. Thought that sound I made was a mouse's squeak. Look!"

With a few whacks from my hunting knife, I laid the bird's stomach open and spread its contents out across my boot top—a quantity of hair and three field mouse skulls, the teeth in each showing plainly.

"Gosh!" again exclaimed my friend. "Mouse skulls and hair, sure enough. And I always heard owls were chicken-killers. Bet you that's what those other fellows are blasting away at, too—owls and blackbirds." He swept his hand upwards toward the grackles which were flowing in almost a steady stream overhead.

Well, I couldn't blame him for what he didn't know, although I felt like saying that a man didn't need to get all his information concerning Nature from hearsay, especially one who spent so much time hunting. Still I'd been that way myself a good deal of my life, and right now I would be ashamed and afraid to face that army of frogs, snakes, ground squirrels, turtles, bats, birds and various other creatures slaughtered by me in the past because they presented a living target for my gun or from hearsay notions that they were harmful. And I believe that remark will apply to most boys born in the country, and for that matter to hunters rather generally.

Take the hawks and owls for example. In southeastern Iowa where I grew up, all the various species of these birds were lumped into one common group as poultry-killers, feathered pirates, to be shot on sight. It was commonplace in our neighborhood to see a big red-tailed hawk or a great horned owl spread-eagled on a fence or the side of a barn as a warning to others of their kind to keep off. Usually, too, a loaded shotgun was kept behind the kitchen door ready for such marauders, and many is the time I have run for the gun, when the shrill cry of some watchful old rooster told me and the hens that Madam Red-tail or hen hawk was cruising over the barnyard. We set steel traps for them, too, upon the fence posts along the pasture, for the hawks like to sit on these vantage points when watching for mice and ground squirrels.

But the pathetic part of the whole business was that although these birds all stood condemned in our sight, we never took the slightest trouble to investigate their guilt or innocence of the blanket charge of "chicken-killer." Not one of us ever thought of examining the contents of their stomachs to see what they had eaten for dinner, and so far as I know, no one in our neighborhood had ever heard of owl pellets, those peculiar balls of fur, feathers and bones coughed up by an owl a few hours following a meal. Indeed, although I must have trampled over many of them—for owls were plentiful in that vicinity—I never saw an owl pellet to recognize it as such until I found them a few years back in a cage where I kept a horned owl. Since that time I have examined hundreds of these curious hen-egg-sized masses of indigestible materials, and they tell me the guilt or innocence of their producer as plainly as do fingerprints among men. True, I found a pheasant skull in the pellet of

a horned owl not long ago, and that of a little spotted skunk in another. But every one that I examine shows from one to four field mouse skulls, sure proof that although this fierce "tiger of the air" does occasionally destroy useful birds, he and his kind are, above all, inveterate mousers. And with the possible exception of the goshawk and Cooper's hawk, the same holds true for all the hawks. A dozen rough-legged hawks and two or three great horned owls can best all the cats in a county at mouse-killing. Nor are these statements mine alone. They are the considered beliefs of scores of men who have studied the habits and stomach contents of these much-abused birds. Experts on quail-raising as widely separated as California and Georgia are agreed that increased hawk population means increased quail supply—in California, because the hawks kill the ground squirrels which eat the quail eggs, and in Georgia, because they prey upon the cotton rat, another egg-eater. That popular but foolish slogan, "the only good hawk or owl is a dead one," is badly in need of revision.

The itching trigger finger

Yes, I know too well the temptation there is to shoot at a moving target. Yielding to that temptation is what caused me to kill so many creatures in the past—that, and a vast lack of any personal knowledge of the thing killed. You are walking along in a swamp, your trigger finger itching and your nose hungry for the smell of burned powder—no ducks to be seen anywhere. And then presently, with a harsh squawk, a big bittern gets up awkwardly with a great fanning of wings and goes flapping off. Why, your gun almost jumps to your shoulder of itself! But steady now! Suppose you do shoot the bird, what have you really done and what sort of creature have you captured?

It is certainly no compliment to your marksmanship that you scored a hit—a blind man could kill a bittern by shooting at the squawk. And what is the creature when dead? A lean, scraggly thing, all bone and sinew and feathers, and so rankly fishy that even my pet hawks refused one that I offered them a while back—and a hawk can stomach even a bat!

Those grackles, too, have an annoyingly teasing habit of cruising endlessly over your head on their way to roost. You poke your gun into the air and glance along the sights at a glossy old fellow—"Yes, that's about the right lead," you say, "and what's one fewer blackbird or a hundred for that matter out of that host?" you argue with yourself. "All the hunters in the country couldn't kill them off!"

"No? Well, brother Nimrod, when you and the rest of the hunting fraternity begin kidding yourselves with that argument it's time to take stock of the situation.

Last week I was out riding with an old friend and as we passed a bit of meadow less than five miles from my home, he pointed to it and said:

"See that plot there? Well, I've killed a wagonload of prairie chickens off that ten acres, year after year."

Gone

That man is less than 70 years old, yet to the best of my knowledge there isn't a prairie chicken within 50 miles of that spot now—almost none in the whole state. He didn't think they could be killed off.

The Eskimo curlew used to migrate northward through this section by the hundreds of thousands every spring. I haven't seen one now in years. And the same holds true for that great bird, the sand-hill crane.

Within my grandfather's memory—and he did his bit in killing them off—the passenger pigeon swarmed like locusts, rather than birds, over nearly a third of the United States. Audubon estimated that some of the flocks contained two billion birds. In 1857 a bill was brought into the Ohio legislature to protect them from indiscriminate killing. The bill was laughed out of the House, but ironically enough the last passenger pigeon in the world died in a Cincinnati zoological garden just 57 years later.

Can't kill them off? All that we need to do with any animal is to go out after it hard enough, either for food, or fur, or fun, or from a mistaken notion that it is harmful, and we soon chase it into that biological sepulcher which houses not only the dodo and the dinosaurs, but such recent representatives as the great auk, Steller's sea cow, the California grizzly, the passenger pigeon, and the heath hen. There's a score of other kinds of creatures too—the wood duck among them—which are also peeking in at the door of this place right now. And from this chamber of horrors they never come back!

A few paragraphs back, I said that much of my senseless slaughter of wild things was due to my colossal ignorance of them and their habits. As proof of that statement I haven't killed an owl since I first examined an owl pellet which showed me what they ate, nor have I shot a common ground squirrel since I discovered them catching grasshoppers—that half or more of their diet, in fact, was insects. I shot flickers or golden-winged woodpeckers until I blundered on to the fact that they were ant-eaters, that they caught the ants by an amazingly long tongue—so long that it required being folded back over the top of the head under the skin when not in use — and that they coughed up these ants and fed them to their young.

A neighbor's boy and I used to stand for hours "plinking" with a .22 rifle at the swallows and chimney swifts that sported around our old barn. They were under the ban because they carried bedbugs. We never learned that the so-called "bedbugs" associated with these beautiful birds were not bedbugs at all; nor did we ever discover that the chimney swifts built their pretty little nests in our chimney by gluing sticks together with their own saliva. And when the bats began to fly in the evening, we had all sorts of fun striking at them with long poles. There must have been thousands of the little brown bats—as I know them now—flitting uncannily through the dusk around that old barn, but usually managing somehow to make their way safely through our swiftly swishing sticks. We did know they weren't blind, as an occasional victim proved. But we never dreamed that their amazing ability to dodge our weapons lay in the possession of special sense organs in their wings—that one scientist had proved their power to fly safely, even though blindfolded, through a room closely strung with wires. Nor did we know that they were catching mosquitoes and other insects there above our heads—catching them by means of an ingenius trap formed by a web of skin between hind legs and tail—and that they could pick out the captured insects from these traps and eat them without slowing down in the least, devouring one victim, in fact, while snaring another. We never knew that these tiny, furry fliers even drank while on the wing by simply scooping up the water as they skimmed its surface. And when we struck one down that had two small ones clinging to the hair of her breast, we couldn't understand that. It was years, indeed, before I knew that Mrs. Bat carries her new-born about with her as she flies—later leaving them hanging up by the heels at home while she hunts when they have become too heavy to carry.

The sheep with the goats

But if the birds, bats and ground squirrels suffered at our hands, the lot of the snakes and the turtles was even a worse one. We slaughtered every snake we met regardless of size or kind. Some, such as the rattlesnakes, we killed because we knew they were poisonous; others, the blue racers, water snakes, and spreading vipers, because we believed them poisonous, and the rest—well, just because they were snakes. One big, red-bellied species of water snake with a wide, triangular head—the sure sign of a deadly snake to us—was particularly feared. We used to haunt the creek banks trying to get a shot at this beautiful serpent, a creature I now know positively to have no fangs or poison at all.

The little hognose snake or "spreading viper" as it is commonly known, has the habit, when alarmed, of spreading its head flat as a shingle after the manner of a cobra—a trick which literally scared the wits out of us, as it still scares people today—and in consequence, this snake had a reputation next to the rattlesnake's for deadliness. One day, when I had one of these cornered, I accidentally stumbled and fell so that my hand struck the snake, and I couldn't then understand why the creature didn't bite me. But since I have come to know more about snakes I have teased and handled these little serpents by the hour without once being bitten. Indeed, I have not been able to make them bite me—another childish belief gone wrong!

Yet today, it is only the occasional person who doesn't club every snake he meets, without discrimination. Recently, while upon a morning's stroll with a friend we chanced upon a six-foot bull snake. Taken by surprise, the big serpent flung himself hastily into fighting position, puffing up with air and hissing loudly as he exhaled. My friend grabbed a club but I restrained him.

"Wait a minute," I said, and then proceeded to maneuver Mr. Bull Snake out of position. In five minutes, I had his neck firmly gripped between thumb and finger and he had his thick body tightly coiled about my arm. From the pressure he was exerting, it was easy to see how helpless a ground squirrel or even a rabbit would be in his clutches, but I discouraged his squeezing act by pinching his neck, so he presently decided that I had him at a disadvantage, and uncoiled from my arms.

"Look!" I said, as the serpent gave up the battle and began to run his head exploringly along my arm. "Watch his tongue slide out of that little hole at the end of his jaws and dance there in the air. He's trying to find out what sort of creature has captured him. And feel his scales—sleek as glass! Isn't he a beauty?"

But I think my enthusiasm was largely wasted.

"What's he good for?" growled my listener. "He'd have bitten you, wouldn't he? He kills other creatures, doesn't he?" These were the questions he fired at me as he watched the big reptile slither away into the weeds.

Economic value

I explained patiently that if an animal had to have an economic value to save its life, Mr. Bull Snake was a mouse and ground squirrel hunter and a rat-killer of parts, that most of our common snakes destroy pests of our farm crops, although the garter snakes do swallow the useful toads and earthworms as well as the harmful grasshoppers.

Of course, the bull snake would have bitten me if I had given him a chance. There are few animals ex-

cept the common rabbit that won't bite when first handled. And as for the accusation that the bull snake is a "killer"—well, how else has man attained his present position? But my friend showed by his expression that he was unconvinced. "He was too old," he told me, "to see beauty in a snake's scales." A snake was still a snake to him, and I know that if we are ever to stop this foolish slaughter of our wild, non-game animals, snakes or otherwise, we'll have to get the argument across to those whose arteries and prejudices haven't yet begun to harden.

From primeval times man has killed other animals for food, and will doubtless continue to do so. It is hard for him to work against his heredity. Even that soft-hearted nature-lover, Thoreau, confessed that the hunting instinct was born in him and in every man—that he could only "pity the boy who had never fired a gun."

For my own part, I love the soft winnowing of a duck's wings overhead after sundown, or the swish of a horde of bluebills stooping to decoys. I know, too, the kick that comes from watching a pair of high-flying mallards fold up and come crashing earthward at the twin flashes of my gun. I have responded to the heavy surge of a big fish on a taut line, and have known the wordless comfort of a well-filled game-bag and pleasingly tired legs at the end of a day in the open.

But I have known, too, that sickening sensation on seeing a great marsh empty of the ducks that once covered it, and have stood by silent fields that once resounded endlessly to the boom of the prairie chicken. I know, too, that an empty beer can tossed into the air offers as good a test of your marksmanship as any blackbird or swift or bat or hawk, and a grizzled old woodchuck framed in the door of his rocky den, shoe-button eyes shining, nose twitching, and funny little black hands holding a bit of clover is a far more pleasing sight than that same woodchuck dead and eviscerated by a high-velocity bullet. For alive, I can visit him tomorrow and tomorrow and tomorrow. And so can you. Why kill that animal?

DO NOT MISS

Everyone whose exploratory disposition quickens to the lure of so colorful a country as New Zealand cannot afford to miss **AN EVOLUTIONIST LOOKS AT THE MAORIS,** by the celebrated scientist Dr. William K. Gregory, in the March issue of NATURAL HISTORY.

Animals are said to give primitive man over half of his words. We may forget our fellow creatures in many other ways, but in **SPEAKING OF ANIMALS** James G. Needham will show in a thoroughly amusing way that animals give us the most picturesque expressions in the King's English.

GEORGE ELWOOD JENKS will return to NATURAL HISTORY Magazine with another dramatic picture story of insect life. In this will be shown the activities of an enemy of the wily trap-door spider, activities which take place largely within the spider.

Extraordinary close-ups of magpie life will be presented in **RAISING A FAMILY OF THIEVES,** a story of this bird from the first moment through the first month.

Those whose thoughts are turning toward the vacation land of the West will enjoy a pictorial excursion into the country of the Colorado, in which Josef Muench will show you **A CANYON RIVER** which has three waterfalls higher than Niagara and harbors an entire tribe of Indians within 13 miles of its length.

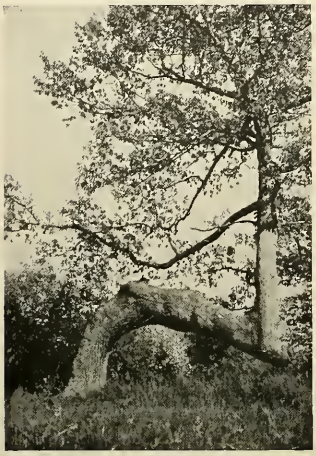
The influence of the symbolic eagle on man's life is one of the most basic stories in the whole gamut of emblematic lore. Lucy Embury's **ODYSSEY OF THE EAGLE** will present an absorbing panorama of the winged figure which more than any other followed man's thoughts through the ages.

TRAIL SIGNS OF THE

By RAYMOND E. JANSSEN

(Photographs by the Author)

WHEN camping in the woods or while hiking along some forest trail, have you ever come across an old Indian trail marker? Perhaps you have but did not recognize it as such. You might even say, "What! Indian trail markers still standing in this day and age?"



A TYPICAL *Indian trail sign with only a single new stem*

Yes, even now we may still see old Indian trail signs in many places. They are most numerous in the region about Chicago, but may also be seen in various localities throughout the Mississippi Valley, in Texas, and in the Great Smoky Mountains and Pocono Mountains in the East. I have seen them in southern Illinois, Michigan, Wisconsin, Ohio, Indiana, Kentucky, Tennessee, Missouri and Arkansas. So if you keep your eyes open for them, you run a good chance of locating some, which even the local residents may not recognize for what they are.

These trail signs are the result of the Indians' custom of bending saplings and fastening them in position so that the direction of bend indicated the route to be followed.

A long line of similarly bent trees could thus be followed by proceeding from one bent tree to the next. In bending the young trees, care was taken so as not to break them; as a result, they did not die, but continued to grow in the deformed position. Although a hundred years and more have elapsed since the Indians were forced westward by the advancing white man, their old trail markers may still be growing just as they were when bent so long ago.

In bending, the main stem of a young sapling was pulled downward and tied in position with a tough vine or strip of rawhide. The tree was always bent so that it pointed parallel to the trail. After a time the fastening would rot away. By then, however, the tree was permanently deformed.

This bending of young saplings radically affected their later development. The original branches, having been turned downward toward the ground, usually died and decayed. In the meantime new stems, or secondary trunks, were put forth by the trees. These extended upward from the bent trunks toward the sunlight and bore leaves in the usual manner. In the course of time the tips of the original trunks usually decayed, leaving the trees with a sort of "arm and elbow" appearance. Occasionally the original trunk tip took root at its point of contact with the ground. When this happened, the tree functioned thereafter with two sets of roots. Growth rings on trail trees show that they were severely stunted. Their sizes, therefore, are not as great as normal trees of the same age.

(Above) SOMETIMES *trail markers, after being bent, took root where the trunk tips touched the ground*

(Left) THIS *red oak, made into a monument, once marked an Indian trail at Evanston, Illinois*

Occasionally when no young tree happened to be growing in a spot where a trail marker was desired, the Indians resorted to the bending of the lowermost branch of an older tree. The effect upon that particular branch was similar; the branch put forth new side branches which extended upward at an odd angle from the main one.

These markers were spaced at intervals depending upon the density of the woods or other conditions encountered along the route. At the town of Highland Park, Illinois, just north of Chicago, there is a marked trail extending from the shore of Lake Michigan to the site of a former Indian village in the Skokie Valley five miles away. In this trail the closest markers are less than 200 feet apart, and the farthest more than a half mile. Thirty years ago there were eleven markers along this route—today only seven remain.

When looking for Indian trail signs, one must remember that not every crooked tree is a trail marker. A large tree may fall upon a young one, pinning it down long enough to cause a permanent bend. Lightning may split a tree, causing one portion to fall or lean in such a way as to resemble an Indian marker. Wind, snow, or injuries done by animals may also cause permanent deformities which might be misinterpreted. Ordinarily, however, such accidents cause the trees to bend in a wide arch beginning from the base. Indian trail markers are never bent from the base of the tree. The bend is usually from one to five feet above the base, and forms an acute angle. In any event, a line of similarly bent trees spaced

(Above) AFTER *being bent, this old oak put forth three new stems, but only two have continued growing during recent years. It stands near Glenview, Illinois*

INDIANS

at intervals and all directed parallel to each other would eliminate the possibility of accidental deformity.

Long ago our country was criss-crossed by a vast network of Indian trails. Many of them were later utilized by the white man when establishing his first wagon roads. Some have been used for railroads, and others have become hard-surfaced super-highways for modern automobile

WHEN *no sapling was available, the Indians sometimes bent the lowermost branches of an older tree*

traffic. Where once the red man pitched his wigwam there now rise tall structures of steel and stone. The tread of soft moccasined feet has given way to the roar of the streamlined express. But as one civilization has been supplanted by another, remnants of the earlier still remain in the form of old Indian trail signs dutifully pointing the route as they did when first bent by the hands of the red men a century or two ago.

(Below) VISITORS *to the Wisconsin Dells may see this old trail marker growing near Stand Rock*

INFORMATION TEST

A few informational high spots that may be gleaned from this month's NATURAL HISTORY

Score 5 points for each correct answer. Correct answers on page 128.

1. Ants confronted with fire have been known to squirt their abdominal fluid on it and put it out.

True..... False.....

2. If you were caught in the desert without water, would you gain by killing your camel for the water in its stomach?

3. Does shaving encourage the growth of hair?

4. Is it true that "the only good hawk is a dead one?"

5. A triangular-shaped head is a sure sign of a deadly snake.

True..... False.....

6. What creature other than man is known to form both pontoon and suspension bridges?

7. Will the tip of a tree send roots into the ground if bent over?

8. The Portuguese man-of-war's sting is from its

(a) Mouth

(b) Tentacles

(c) Ejected fluid

9. How would you get a strong moonlight effect most satisfactorily in daylight photography?

10. The spider is an insect.

True..... False.....

11. Is there a milk snake which enters barns at night to milk cows?

12. Does an ostrich when frightened stick its head in the sand?

13. A disease resembling a type of human cancer is known to follow hereditary laws in certain fish.

True..... False.....

14. What animal has a day named after it?

15. Do life insurance companies increase rates if there has been cancer in the family?

16. What does a flying bat do that is similar to a locomotive making a non-stop run?

17. Is there a whip snake which whips its prey to death with its tail?

18. Do a person's fingernails grow after death?

19. Spiders have skeletons.

True..... False.....

20. Monkeys confronted by an alligator infested stream are known to form a living chain from one tree to another in order to cross.

True..... False.....

GAMBLER ON THE GOBI

The Story of Roy Chapman Andrews

By D. R. Barton

Poets, it has been said, beget poets. The process is spiritual rather than biological and is, happily, common to all professions wherein a man can model himself after the deeds of another. But the remarkable fact is that poets frequently beget strange hybrids and even diametrical opposites, which is very much to the good, since it takes all kinds to make a world, and—as this writer has been at some pains to demonstrate—it certainly takes all kinds to make a Museum.

Forty years ago, the son of an obscure rural druggist in southern Wisconsin picked up a volume called *A Handbook of North American Birds,* by a certain Frank M. Chapman. This boy had owned a gun since the age of nine and he loved to shoot. He also loved to mount the things he shot, and became the star taxidermist of that region before he had finished grammar school. Despising all studies except nature lore, he wanted to spend every moment in his native woodlands and he very nearly did. Chapman's book went along on each camping trip. It was his bible, and its author was Roy Andrews' hero. His entire youth was focused on one burning ambition—to meet Frank M. Chapman and to follow him in the career of natural historian.

They met, finally, on a July morning in 1906. There they stood, like cow-puncher and fencing master, the Wisconsin recruit—rangy, big-handed, a head and a half the taller—trembling in the presence of the courtly, quiet spoken ornithologist. It was one of Doctor Chapman's earliest and assuredly one of his most fruitful conversions.

And yet how polarized were the personalities involved. The course of Doctor Chapman's life* reveals a curiously contemplative nature. We can discover almost nothing of the sort in the career of Roy Chapman Andrews. He is all action. His books are written in a terse, chatty journalese that contrasts sharply with the measured and often classically intricate sentence structure of Doctor Chapman. The latter's photographic illustrations show nearly everything except himself, and in his one or two appearances he is self-described with characteristic aloofness as "the author." By contrast, publisher Putnam has scattered action-shot portraits throughout Andrews' books, and here also the captions are characteristic. With a perfectly natural simplicity, he calls himself merely "Andrews." And thus we shall speak of him here.

If Doctor Chapman seems a kind of metallic beacon glowing with a slow luminescence, then Andrews is a fiery comet. And the fuel of that fire is his insatiable appetite for kinesthetic experience. He was never content merely to see the world. He wanted to *feel* it—all of it—and wherever possible to wrench out whole chunks as scientifically priceless souvenirs.

His career is almost pure Alger, with a robust leavening of Kipling, P. C. Wren and even a dash of Sax Rohmer. Unlike Doctor Chapman, he made no stop-over as a misfit in a bank. His blessing has been a sheer genius for finding a milieu wherein his problems can be solved by his great forte—direct, aggressive action.

Doctor Andrews *photographed against eroded collecting area in the Gobi Desert*

* See "Apostle of the Birds," by D. R. Barton, Natural History Magazine, January, 1940.

The boy arrives

He had been turned down at the Chicago Museum and at Pittsburgh when he arrived, well-nigh penniless, at the corner of Central Park West and 77th Street. He was about to play the last hand in the first big gamble of his life. The chips were low. But it was his own money. Taxidermy had paid for his education. It would pay for this gambler's trip. His father could have afforded both trip and education, but young Andrews was very much on the independent side and he wanted help from no one. The Museum doors were not yet open, and he walked several times around the entire building before settling to fret on a large rock in Central Park just across the street from the Museum. Finally, an attendant ushered him into the office of Doctor Bumpus, then Director of the institution. The Director shook his head at the young man's request.

"No job," said he.

"But surely you need someone to wash the floors."

Doctor Bumpus felt that a man of young Andrews' education would not care to wash floors.

"Not *any* floors," Andrews replied, "but the Museum floors are different." This was evidently the right answer. For Doctor Bumpus gave Andrews a place in the Preparations Department where he washed the floor, mixed clay and did all sorts of odd jobs.

Those of us who have seen the enormous model of the sulphur bottom whale hanging between the second and third floors are looking upon the first local achievement of the boy who came out of the Wisconsin woods, later to rise via the field of exploration, to become Director of the American Museum of Natural History. Andrews was dispatched with James L. Clark to fetch the skeleton of a whale that had been buried in the sand of a Long Island beach in mid-winter. Although he encountered maddening difficulties and had to work waist-deep in freezing brine, he carried out his instructions so faithfully that in the spring, Director Bumpus sent him on a one-man whaling expedition to British Columbia. Thus began Andrews' eight-year exploration of the lives and loves of those sea-going mammals known as the Cetaceans. There followed several expeditions to northern waters, and although he became the leading authority on whales before he was 30 years old, he absorbed more than the precepts of formal science. He learned the science of handling men. Andrews was thrown in with rough longshoremen, sailors and whalers who twitted him, played pranks upon him and at first were inclined to scoff at his scientific credentials. But before long he had won their respect by his adventurous enthusiasm which carried him to such feats as drinking whale milk and kicking sharks in the nose when they interfered with his collecting.

By the time Columbia University had awarded a Master's Degree for his thesis on whales, Andrews felt that he had exhausted the possibilities of whale study. His nervous system simply was not adapted to sitting down in a laboratory or a library and amassing all the knowledge of whale life, to be synthesized into a long series of monographs which would take up the rest of his life. It was imperative that he have new worlds to conquer.

ANDREWS *and the celebrated dinosaur eggs*

He first took leave of the western hemisphere when the U. S. Navy invited the Museum to send a representative on the cruise of the *S. S. Albatross* to the East Indies. Andrews was obviously the man. Happy as a boy let out of school, he boarded the *Albatross* and sailed off to the blue Pacific of legend and romance. Soon he was "shipwrecked" on an island with not one but two Men Fridays, and although the natives feared they would starve to death, Andrews had them calmly eating monkey meat and going about the business of collecting birds, mammals and reptiles. When the *Albatross* finally returned, they went on to other islands. His collections grew by the day, the month, the year. Then just as the ship was about to sail for home, Andrews saw an opportunity to investigate whales in the Japanese coastal waters. He cabled the Museum for permission. It was granted and he set to work.

Putting up at a Japanese-operated hotel, he inquired if he could have a bath. Certainly. He was lucky, too. Only five other people had used the water previously. Having settled somewhat squeamishly into the tub, he was interrupted by the host bringing a young girl into the room with the announcement that she would wash his back.

"Oh, no she won't."

The host departed but soon returned with another girl. "*This* girl will wash your back," said the host. Andrews ordered them out. The host became almost tearful and pleaded that if Andrews would not accept this second girl, he would be obliged to secure a *geisha*. Andrews finally submitted. Since then he has always maintained a strictly *laissez faire* attitude toward oriental customs.

The rôle of the explorer

Explorers are divided into two classes—hot men and cold men. Doctor Chapman is a clear example of the former. At the first flurry of snow, he has for some 30 years fled to the tropics where he feels completely at home and enjoys excellent health. But although Andrews managed to bear up under the rigors of his East Indian expedition, he became convinced that he definitely belonged to the "cold man's" school. He had seen the tropics and enjoyed them, but he wanted no more.

It may be said that a Museum's personnel is divided into three parts. There are the scientists; then the artists who present science to the public; and finally, the explorers or field men who go out into the far corners of the earth to bring back the raw material from which the scientists deduce the secrets of nature. Indeed, it is the explorers who supply the life blood of the Museum.

From the time that he dropped the study of whales, Andrews gravitated more and more toward this last specialty. About 1916 he became enthralled with the idea of exploring the deserts of outer Mongolia and undertook two small reconnoitering expeditions in the surrounding region.

He was stimulated in this ambition by the writings of Museum President Osborn, who as early as 1900 had placed the dispersal center for mammalian life, including that of Man, in Central Asia. Many other students derided the notion. "You would find sand and stones," said the scientists, "not bones." But Andrews' enthusiasm was aroused. With Professor Osborn's blessing, he strode into the office of J. P. Morgan and came out half an hour later with $50,000. On he went. He talked, lived, ate, slept, dreamed—and *sold* Gobi. He was stumping New York's four hundred for the most complete, best equipped and best manned land expedition in history—and all on a gamble. He simply believed in the Gobi.

Andrews was convinced that motor transport could be used across this gravelly desert. It was part of the gamble upon which he staked his reputation, Professor Osborn's reputation —that of the American Museum itself. If he was right, the desert could be traversed ten times as fast by large motor cars as it could have been by camels, the only transport available to the handful of previous investigators.

Almost a nervous wreck, he arrived in Peking in the spring of 1921. In April, 1922, the first unit of five Dodge motor trucks, with a group of six scientists and 22 native helpers set out in the trail of their own camel caravan which had been sent forward months before to leave deposits of gasoline at specified posts in the desert. Fighting their way through sand storms, bandits and other difficulties including 40° overnight drops in temperature, this personnel carried out the first phase of perhaps the most revelatory excavating work ever done in the science of palaeontology. The expedition discovered the first dinosaur egg, the largest known land mammal and the largest known carnivore. They established Asia as one of the chief sources of the origin and distribution of animal life. Doctor Osborn's theory was substantiated. Andrews' great gamble was won.

Moments in Peking

Since the Gobi winters are extremely cold, this expeditionary work could be conducted only during the warm months. In the fall, Andrews retired to Peking, entering boisterously into the polo matches, the horse races and the social life as centered in the foreign legations, where, he says, "there were some people who played mahjong and bridge, but I never met them."

Andrews set up laboratories and general headquarters in a former prince's house. In this setting he proceeded to fall deeply in love with Chinese life, describing it as an Aladdin's Lamp existence in which everything is turned over to the almost magical ministrations of the Number One Houseboy. He had but to breathe his intention of summoning 25 or 30 guests for dinner, and a flawless banquet would appear, although the household boasted silver and glassware for only half that number. But by the same token, the Andrews were sure to meet their own particularly fine candlesticks and fish plates at every dinner party they attended. For all Number One Boys were in constant touch with the activities of each other's households, and if one of them had to serve a banquet, the others would supply all deficiencies.

The institution of "bombing breakfasts" is something which amply illustrates the *opera bouffe* quality of the Chinese warfare that sputtered continually throughout the first few expedition years. The Andrews and several guests would repair to the roof of the Peking hotel to watch a bombing plane soar over the ramparts of the city. The inevitably poor marksmanship of the fliers guaranteed the safety of the guests and nearly everyone else. After having partaken of food, the party watched the performance somewhat as Nero did the gladiatorial combats. The bombing breakfasts were, however, far less bloody.

With the intrusion of Soviet arms and propaganda into this area, the comic opera aspect suddenly vanished. Previously, by a combination of tact and the American flag Andrews had been able to go through China and Mongolia much as he wished. But from this time onward, he discovered that the American flag pasted on the side of his expeditionary cars no longer meant anything. Nevertheless, accustomed to shuttling back and forth through the war areas, he continued to rely on his utter contempt for the Chinaman's ability to shoot and once drove a car at 50 miles an hour through a firing line of Chinese soldiers while his companions lay on the floor of the tonneau. Bullets splintered the windshield and thudded into the body of the car. Then several soldiers climbed on the running board. The vehicle became so over-weighted that eventually one of them fell off and had his hand "simply shredded" under the rear wheel. The expeditionary party escaped death only on the timely appearance of an officer.

Paradoxes

Until 1934, Andrews had never spent 12 months in any one country for 25 years. During this perennial odyssey, he had narrowly escaped death from wild animals, typhoons, bombing planes, and the accidental fire of his own revolver. Although this would seem to make exploring a decidedly dangerous undertaking Andrews is inclined to pooh-pooh the idea. He once nearly killed himself answering the telephone, loves to recount the number of deaths occurring from accidents in bathtubs, and generally decries the idea that the far places of the earth hold dangers comparable to those that one meets in everyday life in New York City. After this rather apologetic beginning, however, he will launch into some of the most hair-raising experiences that any man has ever come through to describe. He has fought Chinese bandits, killing at least one of them and chasing many others in his car while he shot above their heads. And he stoutly maintains that he would rather face a Chinese

bandit any day than an American gangster. Not that his ungovernable curiosity quails before the latter. By no means. On one of his rare visits to New York during the expeditionary years, he bumped into a gangster-police gun fight within two blocks of the Museum. Spotting a reporter friend, he borrowed a press card and went up the steps with the police to the brownstone house where the criminals were hiding. He was prevented from entering, of course, which is probably just as well, since two men were subsequently wounded and another killed.

It was this same curiosity that prompted him to don a Mongolian disguise and risk life and limb to witness a secret religious ceremony in a Lama temple where no white man had ever entered. Moved by the same reckless spirit, he once abandoned a digging job in the middle of the Gobi and got lost chasing a pack of wolves. The wolves were dangerous to the natives, of course, but at bottom it was simply the thrill of the chase, the desire to pick up his gun and go that urged him on. Time and again Andrews has voiced complete agreement with Stefansson's dictum that adventures in the course of an expedition are a mark of incompetence. Yet he himself has placed his life in danger many times at least partly due not so much to necessity as a natural response to the adventurous hunter's instinct.

That this compulsion has never seriously jeopardized any of his undertakings cannot be attributed, however, to a charmed life. There is paradox in this seemingly coltish irresponsibility. Behind it all is a shrewd, skillful organizing ability and the equipment of a good poker player. He knows when to take his chance. For too much caution can become a serious handicap when one is engaged in handling men over long periods in the field. Andrews knew this. And he was naturally endowed with the qualities to inspire those whom he led with a feeling of confidence. Like a general, he demanded that his men place his judgment before theirs and obey his commands implicitly. Underlying all the high adventure of his expeditionary work lies the fact that it was made possible by careful foresight and Napoleonic strategy. It was in every sense a military undertaking, requiring knowledge, not only of the terrain explored but of the men who were to do the exploring, what their problems were and where they were most apt to succeed in their special division of science.

The Central Asiatic Expedition made exploring history. It was the first party ever manned by specialists drawn from so many fields—topographers, geologists, palaeontologists, botanists and archaeologists. Yet its leader was none of these. His particular task lay in knowing enough about each of these specialties to keep the men in hand and concentrate their amazing battery of skills on the solution of the problem of mammalian origin. Without the assistance of all these sciences, the celebrated "Dune Dweller" culture could never have been accurately dated. This alone would have been sufficient to justify the maintenance of a large personnel. But there were many other vindications, too numerous to mention here.

Plans had to be made in a manner that would anticipate every possible hazard and vicissitude, not only of actual field work, but of allocation of funds to purchase the supplies and all other pertinent details. For instance, Andrews is almost as proud of the prompt scientific publications as he is of the discoveries themselves. He believes that no expedition should ever be organized without due provision for the speedy publication of its field results. Without these, the work becomes almost valueless, since it cannot be passed on to other specialists through the medium of the printed word. Out of a yearly $50,000, Andrews would often devote $5,000 to the publication budget so that the technical papers constantly kept abreast of activities in the field. This was well-nigh an unheard of achievement. One other Museum expedition, which Andrews holds up as a prime example, is still bringing out its papers, the bulk of which have not been published after 30 years!

As to the Gobi specimens, they are in the hands of men like John Nichols in the Fish Department who never went on the expedition, but whose expert knowledge of the fishes of the world equips him to deal most effectively with these piscine treasures. The work in mammals is also in the hands of the most competent men available. Although many of these specimens

Continued on page 128

HOME *is where your tent is. A silhouette of Andrews in the Gobi*

ANIMAL FABLES—*Continued from page 87*

Many animal fables or superstitions have essentially the same origin as the story of the bumblebee "bugler," namely misinterpretation.

Dramatic or melodramatic literature has done much to popularize ideas about animals, both true and false. We have, for instance, the story of the caravan dying in the desert for lack of water. When all else fails, the travelers slaughter their faithful camel to drink the several gallons of cool, fresh water contained in its marvelous multiple stomach.

When Alfred E. Brehm came to Egypt, he inquired about that story from old caravan guides who of all people should know everything about the "ship of the desert." They energetically denied it. Just to be certain, Dr. Brehm had the stomach of a camel opened. Although the animal had drunk plenty of fresh water only the previous day, its stomach contained nothing drinkable.

It has always been a human tendency to divide animals into two classes: the "stupid" ones (like the ostrich) and the "cunning" ones (like the fox). Of the latter, the scorpion is prominent if one considers its alleged ability to anticipate death. For the scorpion is said to be the only animal that commits suicide when trapped. The story dates from classical times: if a scorpion is placed in a circle of glowing coals from which it can find no avenue of escape, it finally commits suicide by stinging itself in the head.

As may be imagined, a good many people in countries where scorpions are abundant must have made the experiment. The English scientist, W. G. Biddie, experimented with Indian scorpions in Madras. He placed them in bright sunlight under a glass bowl so that they could not run away and began to burn them by means of a reading lens. They were finally burned to death, not even trying to commit suicide. But Dr. C. J. Wills reported quite different results from Shiraz, Persia. He placed scorpions inside a circle of burning coals. Every one of them stung itself and died quickly.

These reports prompted one Dr. G. Budde to perform a fairly long series of experiments with several varieties of scorpions. His first specimens were *Scorpio europæus* from Italy. As a preliminary test he stung one of the scorpions with its own stinger. The scorpion became weak, but recovered, proving that it is not totally immune to its own poison. Then he proceeded to construct the fiery circle of the ancients. Its center was not too warm for his finger. A scorpion which was put in the middle grew agitated and suddenly ran in the direction of the largest and brightest coal. Trying to crawl under it, it burned itself to death. These and other experiments in Istanbul led Doctor Budde to a clue to the origin of the myth. While the bodies of the scorpions were burning, their tails thrashed around wildly and several spectators, acquainted with the story, exclaimed repeatedly: "Look, now it has stung itself!"

It is strange that entirely wrong notions of folklore have found wide publicity for centuries while some of the really remarkable facts are practically unknown. If there were as many ant stories as there are scorpion stories, it would be understandable. But most people have never even heard of the ants' "fire brigade," and if they have, they are likely to dismiss it without further inquiry.

A number of years ago, an Austrian amateur scientist by the name of Friedrich Gedde set out with simple equipment to see how ants behave in the presence of fire. He chose an anthill in the Austrian Alps for his experiment, and stuck a candle in it. The ants, of the common red variety *Formica rufa,* came at once to investigate the as yet unlighted candle and, after discovering that they could chew the stuff, began to carry particles of it away. Then the candle was lighted. The flame was about one and one-half inches high and about the same distance above the surface of the anthill. All the ants in the vicinity stopped at once in their tasks and looked at the flame. A few approached it and jumped into the fire, probably trying to bite the flame and thereby burning themselves to death. After about a dozen of them had died, the ants changed tactics. Large individuals climbed up on the candle, and at the rim reared themselves on their four hind legs. In this position they sprayed the fire with their abdominal fluid.

Although their legs and antennæ were scorched in the process, they took time to aim carefully. Meanwhile a few hundred ants were busy building a ramp of dried pine needles for a better approach. Some of the needles caught fire, but were extinguished quickly. Not quite five minutes after lighting the candle, it went out; the ants had soaked the wick with their liquid. They rescued their dead, repaired the damage done to the hill, and tried to bury the candle.

Half an hour later the candle was relighted and the ants repeated the procedure. It took them hardly half a minute to extinguish the flame the second time.

This experiment proves conclusively that ants do fight fires, although it seems reasonable to doubt that they do so with full knowledge of what they are doing. The natural weapon of the ants for enemies out of reach of the mandibles is their liquid, which happens to be effective as a fire extinguisher. It is also very probable that there is not a special "fire brigade" since all the workers can eject the liquid.

An article on fabulous animal stories would cer-

tainly be incomplete without a few references to snakes.

No other group of animals, not even the bats, ever received a more adverse reputation than the snakes. One fable credits snakes with a "hypnotic gaze" supposed to root the prey to the spot so that it cannot escape. It is mainly the very large snakes that are said to possess the ability of "charming." The legend not only occurs in Asia but is also current among certain tribes of American Indians. James Adair preserved such a tale, told to him by his Cherokee friends, about some very old and large rattlesnakes in a hidden valley. "They are so large and unwieldy," he wrote, "that they take a circle almost as wide as their length to crawl around in their shortest orbit; but bountiful nature compensates them for the heavy motion of their bodies; for, as they say, no living creature moves within reach of their sight but they can draw it to them."

Needless to say the "hypnotic gaze" is nothing but a legend. So are most of the other snake yarns, like that of the whip snake, supposed to whip its prey to death with its tail—no snake ever used its tail in such a manner, although some of the larger lizards make it a weapon—or the milk snake that is supposed to milk the cows. That story is told in America about *Lampropeltis triangulum* and in Europe about several varieties of harmless snakes which can all be found in barns, where they go occasionally, probably to catch mice or to keep warm.

Of all the fabulous stories none are as deeply imbedded as those about snakes. If you run across someone who has heard that camels carry a fresh water supply in their stomachs, you will be able to convince him that an animal's stomach is no icebox. And you may be able to separate him from the idea that the ostrich buries its head. But if you start to explain to a hardened woodsman that snakes don't jump, and don't milk cows, that they don't move in hoops and, most important, that the Great Horned Serpent has never been verified—you might as well stop before you have started. Because—well, because people just like to believe them.

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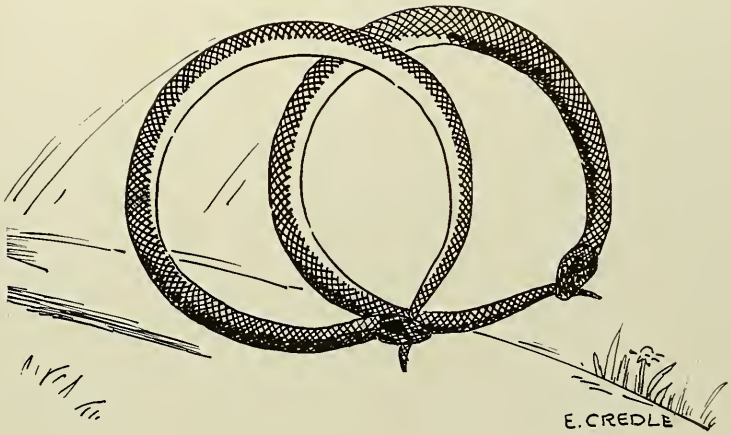
[1] Mathias Tresch, *La Fontaine naturaliste dans ses fables* (1902).
[2] E. W. Gudger, "How Rats Transport Eggs," *Scientific Monthly*, May, 1935.
[3] E. W. Gudger, "The Myth of the Monkey Chain," NATURAL HISTORY Magazine, February, 1919.
[4] Auguste Forel, *The Social World of the Ants* (London: G. P. Putnam's Sons, Ltd., 1928), II, p. 97.
[5] *Ibid.* p. 277.



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BOOK OF THE BROADLEAF TREES

- - - - - - - - - by Frank H. Lamb

W. W. Norton & Co., $3.75

THE author of *Sagas of the Evergreens* has now given us a very attractive book on the broad-leaved trees, copiously illustrated with beautiful and arresting photographs. The first chapter, entitled "Out of the Past," is a non-technical discussion of the ancestors of trees. In fact, throughout the book the author shows his interest in geological history. In this excursion through the forests of the world, he says, "The mileposts will be fossils of successive ages embedded or embossed in the rocks beneath the forests. . . ."

But this is not a book on paleobotany. The publishers say it is no scientific treatise, and no popularization. The first part of this statement is certainly true, but the second is not so clear. To this reviewer it is good popular scientific writing, a relatively rare achievement. When we recall the writings of Thomas H. Huxley and Sir James Jeans in other fields, we realize that "popularization" is not a derogatory term.

We should like to see the Latin scientific names of the trees, at least in connection with the photographs. To place them only in the index is inconvenient, and in some cases it is a little difficult to associate them with the correct common name. We believe that few naturalists would agree with the statement (on page 48), "Emerson, Thoreau and Burroughs were dilettante naturalists, using nature more as a vehicle for presenting their philosophical and sociological ideas." There is considerable truth in this generalization about Emerson, but certainly not about Thoreau and Burroughs.

In the statment, "As their common names plainly imply, mockernut, pignut and bitternut hickories are not recommended because of the quality of their nuts," it is evident that the author was not aware that the name "mockernut" comes from the Dutch *moker-noot,* meaning "heavy hammer nut," so named because of the thickness of the shell, which requires more than a light hammer to crack, and does not refer to the quality of the kernel. The mockernut should not be grouped with pignut and bitternut for its kernel is sweet.

The chapters of this volume are well written, evidently from a thorough-going background of knowledge and experience, and contain a wealth of interesting information, although there is considerable overlapping. The ground covered is the whole world, and many appealing facts and associations are woven into the story.

CLYDE FISHER.

ANIMALS ARE LIKE THAT

- - - by Frank Buck and Carol Weld

Robert M. McBride and Co., $2.50

MR. BUCK has again published a wandering account, chiefly of his experiences as a collector of wild animals in India and the Malay Peninsula, with a great deal of space given to the habits of certain animals.

The book is well worth reading for entertainment as it tells of many amusing and interesting incidents, but it is not a book to be taken too literally. It is unfortunate that the authors were not more careful about checking up many of their statements before placing them in print. The last chapter titled "It's a Fact" gives a number of scattered notes on Natural History which most certainly should not come under this heading: for example, the statements that the aard vard is an edentate because it has no teeth (an adult aard vard has twenty teeth), and that the armadillo cuts up its food with its "bony plated shield." After reading such statements, one loses faith and wonders just how much of that told in the preceding chapters can be relied upon.

The book is illustrated with a number of photographs, chiefly of animals in captivity.

T. D. C.

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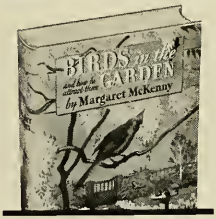

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MANY a new bird book is just another rehash of those already on the market, and practically all are filled with uninteresting descriptions of color, song, habitat, habits, etc. Now there has appeared a bird book which approaches the subject from the unusual point of view of the botanist and garden expert. The book has been written for those interested in attracting birds, providing proper food and shelter for them, and enjoying their presence in the garden. The author, Margaret McKenny, is a well-known botanist and active garden club organizer. Birds go with flowers, are the most attractive inhabitants of a garden. What more natural then, than to present to everyone, useful ways and means of enticing them to make their homes within the family garden where they can be studied at close range! Some of us remember the practical suggestions of Count Von Benlepsch of Hungary on methods of attracting birds, but here is an authentic guide for Americans. Even diagrams are included indicating proper garden planting for birds and proper planning for a bird sanctuary. Poetry is interspersed to bring out esthetic values.

Particularly attractive are the fine colored plates by such notable bird artists as Allan Brooks and Walter Webber and the best of photographs by A. A. Allen, W. L. Finley and others. Many a naturalist has stated that his interest in birds began as a result of pictures in natural history books or the close view of some bright-colored bird. This book offers appealing pictures and describes the methods whereby close observation of birds is made possible. It is refreshingly different from the average bird book and will be the companion volume with each garden guide in the American home.

H. C. BRYANT.

Science Today and Tomorrow

- - - - - by Waldemar Kaempffert

Viking Press, $2.50

WALDEMAR KAEMPFFERT'S pen is not only inspired by imagination but it is controlled by accuracy—two most important characteristics of a scientific writer. Others may set forth their material as clearly, but few can approach his skill in fascinating and persuasive presentation. He has an unusually comprehensive background. For eighteen years he was editor of the *Scientific American*, and for five years he was editor of *Popular Science*. He was the first director of the Museum of Science and Industry in Chicago (founded by Julius Rosenwald). At present he is Science and Engineering Editor of *The New York Times*.

In this volume the author gives us eighteen most readable chapters on astronomical, physical, chemical, and biological topics—every one a gem of popular scientific writing. The reader is given dramatic word-pictures of a nova ("A Star Explodes"), new aspects of the sun, and life on other worlds. There is a chapter on rocketing through space, and one on explorers of the atmosphere. The chapter entitled "The Mystery of the Atom" is a thrilling story. Another chapter is titled "After Coal—What?" Another, "Evolution Since Darwin," and another on "Carrel."

The thread that binds the book in a unified whole is the author's deep and continued interest in the social aspects of scientific development. To him it is a new and improving way of life. There is not a dull paragraph in the little volume.

Clyde Fisher.

Man Makes Himself

- - - - - - - by V. Gordon Childe

Oxford University Press, $1.75

THIS readable book is a brief but fairly comprehensive outline of human culture history as viewed by an anthropologist. It is a thoughtful and thought-provoking account, intended primarily for the lay reader but well worth the specialist's attention as an interpretative exposition. The author's chief aim is to examine the known facts of prehistory and ancient history in order to determine the major events which mark the course of human progress. He begins by suggesting that Prehistory is a continuation of Natural History and that there is a notable analogy between organic evolution and cultural progress. More specifically, he suggests that during the early stages of human existence advancement consisted mainly in physical or bodily *adaptation to environment* and that since modern man came on the scene advancement has been marked instead by modification or adaptation, i. e., *conquest of the environment*.

This conquest process, ordinarily called culture history, is described in a succession of chapters bringing the story up practically to the present day. First, during the Old Stone Age, appeared the simple food-gatherers; next, during the New Stone Age, came the agriculturists and stock raisers, with marked increase in population; last of all, during the Bronze Age and later, urban civilization arose with its division of labor and consequent interchange of products, resulting in navigation and search for raw materials far and wide, giving rise to trading posts, colonization and ultimate conquests. As an essential to successful merchandising, writing and arithmetic were developed and with this achievement historic times may be said to have begun, about 3000 B.C. These major steps were so markedly different in character that the author calls them Revolutions and regards them as equally important with the Industrial Revolution of the 18th Century, which has given rise to our present method of mass production.

But this is only half the story. Economic advancements had all along profound social consequences, and our present difficulties are regarded as arising mainly from the fact that social improvements have not yet caught up with our industrial achievements. To many students, Professor Gordon thinks, our progress is doubtful, is nothing but a revival in scientific terms of the ancient doctrine of the Fall of Man, through tasting of the Tree of Knowledge. And so this essay is intended primarily as an antidote for present pessimism regarding the human future by showing that in the past the world has steadily advanced in spite of, if not because of, a succession of more or less violent Revolutions, of which the present turmoil is only another example.

N. C. Nelson.

The Great Naturalists Explore South America

- - - - - by Paul Russell Cutright

Macmillan Company, $3.50

DOCTOR CUTRIGHT, who is head of the Biology Department at Beaver College in Pennsylvania, presents the naturalist explorers of South America through a short résumé of their travels and a compilation of their observations on certain animals as taken from the printed accounts.

Emphasis is correctly given to Azara, Humboldt, Darwin, Bates, Belt, Hudson, Schomburgk, Chapman, etc. There is no mention of Lund, Goeldi, Burmeister, Rengger, Anthony, Osgood and other important workers in this field, perhaps because most of their contributions are technical. Of the 31 chapters, one is on the explorers, 13 on mammals, 7 on birds, 4 on reptiles, 3 on fish and 3 on insects—thus providing a useful handbook of the forms discussed.

This book is a compilation only—the author has gleaned from other men's writings, and though there are naturally many things of interest in the 340 pages of text, the selection of facts is sketchy and uncritical at times. This, despite the great men cited, renders the book a bit superficial and is probably due to the fact that the author is out of his own particular field (he is a cytologist—a student of cells) and has neither visited South America proper nor apparently studied its fauna. But also, for these very reasons, he has done creditably well.

The book may fill a need for the interested layman, mining man, oil man and week-end explorer; certainly it will "stimulate" the critical mind. The scientist will still read the originals many of which are

Continued on page 127

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INFRA-RED PHOTOGRAPHY

Continued from page 65

insensitive to infra-red radiations and are, therefore, unable to give an accurate indication of the intensity of the infra-red rays reflected from the subject. The question of exposure is seldom a problem because best results are obtained in direct sunlight. On gray, overcast days outdoor scenes cannot be photographed well on infra-red film.

Other than the recommendations made above, no special caution need be given on the use of infra-red film for outdoor photography. No change need be made in the usual method of focusing, since with miniature cameras using lenses of short focal length, the change in focus caused by the use of infra-red rays rather than visible light waves is so small as to cause no appreciable difference in sharpness of the final photograph.† Development and proceeding can be handled by entirely conventional methods, the only necessary modification being a slight reduction in developing time, as indicated on most film instruction sheets.

† The manufacturers of some lenses, anticipating the use of infra-red film with them, put an extra mark on the focusing scale to use in this event.—Ed.

The photographer of outdoor subjects soon finds numerous occasions on which infra-red film is far more helpful and suitable as a recording medium than any other emulsion type which has heretofore been available. In addition to providing the dark sky tones mentioned above, the film is remarkably useful in producing night-effect scenes of subjects illuminated in full sunlight. The character of the recording of foliage and grays produced by the chlorophyl present as explained above, lends an appearance to the scene that makes it seem as if the subject were bathed in moonlight, with soft, deep shadows and dark skies accentuating the dramatic effect.

Photographers have found too, that the film is remarkably helpful in reducing the haze frequently encountered in photographs of long vistas. This haze, a scattering of blue and ultra-violet light by moisture particles present in the atmosphere, is largely penetrated when infra-red film is used, since the film is not sensitive to these blue and ultra-violet portions of the visible spectrum when a filter is used. While this application can be extremely helpful in many instances, it must be remembered that smoke and dust particles in the atmosphere can form a haze which is not penetrated in this way.

The penetrating effects of infra-red radiations are apparent in other fields as well. While infra-red photography is extremely unsuited to portraiture, because of the blank, white skin tones obtained, infra-red film has nevertheless been successfully employed in medical work for the photography of certain sub-surface skin conditions, since the examination with infra-red rays permits much greater penetration than is obtainable by ordinary photography or by visual inspection. Further examples of the adaptability of infra-red photography are evident in other fields, infra-red film being extensively employed in photomicrographic work and in such unusual jobs as the examination of paintings and documents to detect changes or forgeries.

The most important and most practical application of this film, insofar as the nature photographer is concerned, will undoubtedly remain in its use for dramatizing outdoor scenes and for creating an atmosphere of attractive unreality in photographs of ordinary views. Here there are real opportunities and perhaps the best way of taking advantage of them is to put a roll of infra-red film into actual service and see the extent of the difference that can be obtained simply through the use of this unusual film.

Above, the lighthouse at Portland, Maine, stands out snowy white against a sky made unnaturally dark by using Agfa Infra-red Film with a dark red filter (1/25 sec., f/3.5). Below, a more normal relation of tones is achieved with Agfa Fine-grain Plenachrome Film (1/60 sec., f/11) with a yellow filter

YOUR NEW BOOKS

Continued from page 125

classics. Best justification for the book is that naturalists with years of field and museum experience either cannot or will not take time to do such writing.

The photographs (also compiled) are good.

R. M. Gilmore.

NOTICE: Readers are encouraged to submit their own photographs of natural history subjects. Those selected for publication on this page will be paid for at $1.00 each, with full credit to the photographer. Return postage must be included.

HONORS

Dr. E. W. Gudger, Honorary Associate in The American Museum's Department of Living and Extinct Fishes and a popular contributor to Natural History Magazine, was accorded the honor of being elected a Corresponding Member of the Zoological Society of London, on December 20, 1939.

John T. Nichols, Curator of Recent Fishes at the American Museum, received a noteworthy distinction when he was elected an Honorary President of the American Society of Ichthyologists and Herpetologists at a recent meeting in Chicago in September, 1939.

•

PLANETS JOIN "THE LINE UP"

The planets perform in a most surprising way for February visitors to the Hayden Planetarium. Against the scintillating background of the stars, the temperamental and acrobatic antics of the five naked-eye planets are projected, as they present one of the rarest spectacles ever to be seen in the heavens.

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•

FEBRUARY MUSEUM BROADCASTS

"New Horizons" (Natural Sciences, History and Geography), Columbia Network on Wednesdays at 9:15 a.m., E.S.T., and 2:30 p.m., C.S.T., with Dr. Roy Chapman Andrews.

"Men Behind the Stars" (Popular Astronomy and Mythology), Columbia Network on Fridays at 4:15 p.m., E.S.T., with Prof. Wm. H. Barton, Jr.

"This Wonderful World" (Information quiz on Natural History subjects), Mutual Network on Saturdays at 11:15 a.m., E.S.T., with Robert Emory and Robert Coles.

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GAMBLER ON THE GOBI

Continued from page 121

were collected by Andrews himself, he is interested only in organizing their scientific assimilation. He is the miner who brings back the raw ore. It is for the metallurgists to sort it out. Though he is a trained zoologist, perhaps the most curious paradox of Andrews' career appears in the fact that his greatest strictly scientific contributions were made in the field of aquatic mammalogy while the great work of his life was conducted in one of the driest regions on earth.

The wide acclaim, the many medals and other testimonials which the world of science and letters has accorded Roy Chapman Andrews, constitute the winner's share in the great Gobi gamble. Had he lost, the Expedition might well have gone down in history as Andrews' Folly. And its instigator might have been classed with Joan Lowell, and Trader Horn, rather than Amundsen and Peary. The Expedition opened the Gobi Desert to motor travel for commercial purposes. It is responsible for most of the maps that we now have of that area. Unknown geological strata were discovered, as well as some of the most priceless fossil accumulations known to science.

Andrews regards it as inevitable that "I should live a life that gave me the wild places of the world as a playground." He has reiterated many times that "exploritis" is a congenital disease and that one is born an explorer. He truly believes he would never have succeeded at anything else.

We are neither equipped nor inclined to dispute the psychological validity of this belief. But to our eyes Andrews bears the familiar mark of the pioneer type which has been in the vanguard of western culture since the discovery of the New World. He grew up close to the 19th century frontier of our own continent and it may well be that he is a spiritual descendant of the Age of Daniel Boone or even of the Age of Drake. Yet if by some twist of fate he had never read Frank Chapman's inspiring hand-book, if he had been moved as a child into a totally different medium, we can readily believe that he would have succeeded equally well even in a more sedentary occupation. The reckless energy of his enthusiasm, the limitless appetite for life, the materialist's touch—would surely have carried him to the summit of any of the many fields of endeavor wherein those qualities are at a premium.

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1. True. See page 122
2. No. See page 122
3. No. See page 85
4. No. See page 113
5. False. See page 114
6. Certain ants. See page 87
7. Sometimes. See page 116
8. (b) Tentacles. See page 72
9. By use of infra-red film. See page 126
10. False. It is classed with the arachnids, which include scorpions and their allies. See page 80
11. No. See page 123
12. No. See page 86
13. True. See page 106
14. The ground hog; February 2nd. See page 85
15. No. See page 106
16. It scoops water up as it skims the surface, as a locomotive does from a trough. See page 114
17. No. See page 123
18. No. The nails of a mummy seem to have grown because the flesh has shrunken. See page 85
19. True. Spiders have their skeletons on the outside. See page 81
20. False. See page 87

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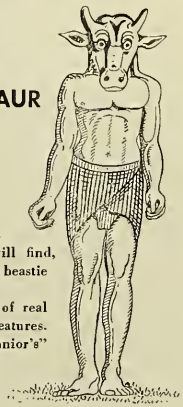

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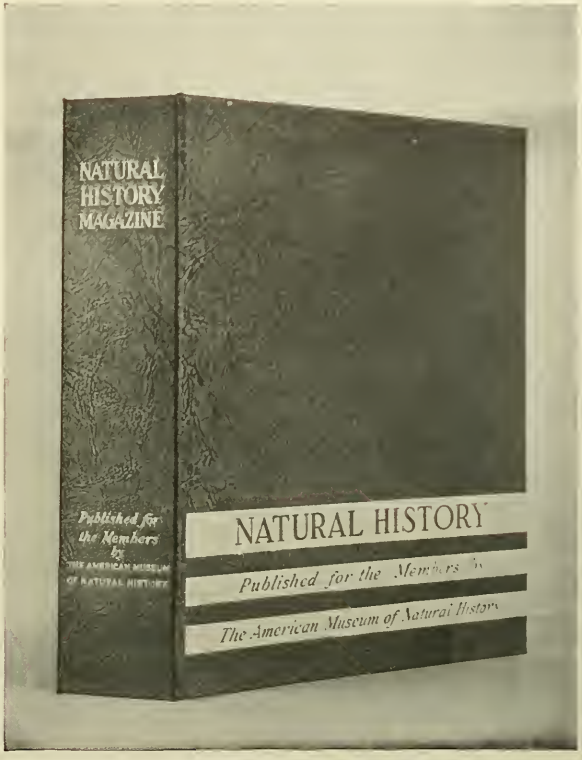

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Above illustration from Bird Group of Hudson Bay Region in the American Museum of Natural History

LETTERS

SIRS:

Your article, "Skyward Again for Pictures," in the January NATURAL HISTORY Magazine explains how one can photograph the night sky to show the trails of the stars in their apparent movements, and I thought your readers might be interested in this example. Since the North Star is often used in place of a compass, many persons suppose that it occupies a position in the sky directly above the North Pole of the earth. The extent to which this is not true is shown in this photograph, in which the innermost bright curve represents the North Star. This apparent motion is caused by the rotation of the earth on its axis, which causes the rising and setting of the sun. The curve here covers about ⅓ of a complete circle, because the camera was left open for eight hours out of the 24, from 8 p.m. to 4 a.m.

It will be noticed that the sky clouded up for a short period around 2 a.m. leaving a gap in each trail. That this gap is greater proportionately in the case of the fainter stars indicates that the sky hazed over gradually, blotting out the weaker beams first and "unblotting" them last.

It is also interesting that the position of the North Star is known to be gradually approaching closer to true north. In this sense it is becoming a better North Star. Astronomers calculate that in about the year 2100 A. D. the North Star, as viewed from the earth, will make its smallest circle.

JOSEPH COBURN SMITH.

Colby College,
Waterville, Maine

SIRS:

. . . Permit me to state right now that of all the magazines I receive, NATURAL HISTORY is the tops.

CARL PIETZSCH.

Clifton, N. J.

* * *

SIRS:

. . . Incidentally, may I also add that there is no periodical that comes to my home which is more satisfactory than the monthly NATURAL HISTORY. The Editor can be proud of the status of this booklet.

SAFFORD K. COLBY,
Vice-president, Aluminum Company of America.

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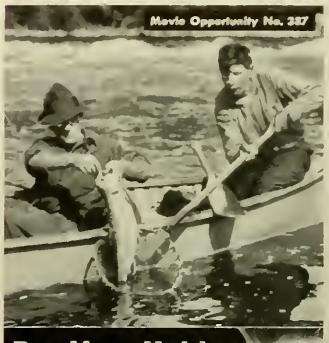

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VOLUME XLV—No. 3 ★ ★ ★ ★ ★ ★ MARCH, 1940

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AN EVOLUTIONIST LOOKS AT THE MAORIS

By William K. Gregory

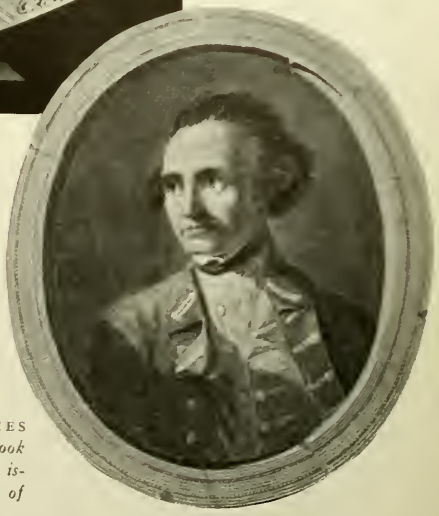
Curator, Departments of Fishes and Comparative Anatomy
American Museum of Natural History

Courtesy of the New Zealand Government

A.M.N.H. Photo

NEW ZEALAND CANOE. *The type of war canoe designed by the Maoris. The hull was skillfully shaped from a single tree trunk. Model in The American Museum of Natural History*

The more than 2000-mile migration of the Maoris across the South Pacific was one of the great voyages of human history. Twenty-three generations in New Zealand have given this virile race a distinctive culture, which today is being successfully united with British civilization



CAPTAIN JAMES COOK, *who first took possession of the islands in the name of Great Britain*

NEW ZEALAND, the land of ten thousand thrilling and true tales, the land that never yet has been adequately made known even to its own devoted citizens! How can we depict this living, moving pattern, made up as it is of so great a multitude of vital strands, each strand leading back into an eventful past? Fortunately for us, a host of historians and naturalists have accumulated abundant authentic material concerning New Zealand, and while our own recent visit there with the Michael Lerner Australia-New Zealand Expedition of 1939 was all too brief, it gave us a very keen interest in the subject and put us in touch with many generous and hospitable scientists and other citizens who spared no pains to show us the wonders of this many-sided Dominion.

Let us start with a great Dutch navigator, Abel Janszoon Tasman,[1] who in 1642 sailed from Batavia in Java and worked his way around the west and south coasts of Australia, discovering the island of Tasmania. Rounding the southern end of the island, he headed east and north, crossing that broad portion of the South Pacific which has since been named the Tasman Sea. Late in that year Tasman sighted a mountainous and rocky land ahead and cast anchor a safe distance offshore.

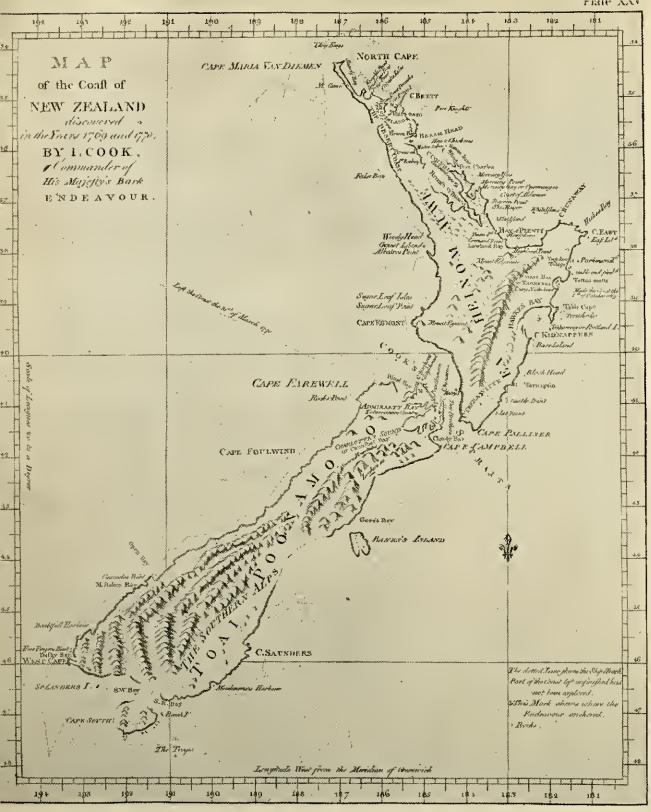
Here was a great land which he later named Staete Land, in honor of his country, Holland. Needing fresh water, he sailed north and northeastward along the coast, finally rounding a long curved promontory and anchoring in a quiet bay at the northwest tip of South Island, New Zealand. This bay is now called Golden Bay but on Tasman's chart it is called Moordenaaers (Murderers) Bay, for there was the scene of a desperate clash with the Maoris.

We realize now with what keen joy of battle these impetuous and aggressive fighters, whose principal life-game was the art of war, put out in their fleet of great canoes and attacked Tasman's landing boats, killing three of the Dutch seamen and mortally wounding a fourth. One of his two ships weighed anchor and zigzagged around what is now known as Tasman Bay. Later both ships sailed along the whole length of the west coast of North Island, stopping at the "Three Kings" islands west of the northern extremity. Here, too, there were hostile Maoris who threatened his boats in their all too eloquent way. But Tasman could not afford to lose any more men to these furious sea devils, so he sailed away, trusting to luck to get water in some less inhospitable place.

For more than 127 years, until after 1769, the Maoris were left in peace, that is, to make war with each other. Then on October 5, 1769, the great English navigator, Captain Cook,[2] sighted the east coast of North Island. On October 9, he came to anchor in a pleasant bay, near the site of the modern city of Gisborne. He and his scientists, Mr. Banks and Doctor Solander, went on shore accompanied by a party of marines, and doubtless the scientists eagerly examined the strange plants and birds. When attacked by the natives on several occasions, Captain Cook and his men beat them off and shot a number of them. Nevertheless he conciliated them whenever possible and was scrupulously fair in his dealings with them. He made several voyages to New Zealand and left the materials for an excellent and authoritative account of the country and its inhabitants. He mapped the coasts with fair accuracy, noted some of the great

(Left) MAORIS *"finger-weaving" a shoulder cloak. When they voyaged to New Zealand centuries ago they needed warmer clothing than bark cloth, yet they knew nothing of loom-weaving. Accordingly they developed "finger-weaving" from their knowledge of basket-making*

Footnote numerals refer to publications on New Zealand listed on page 145



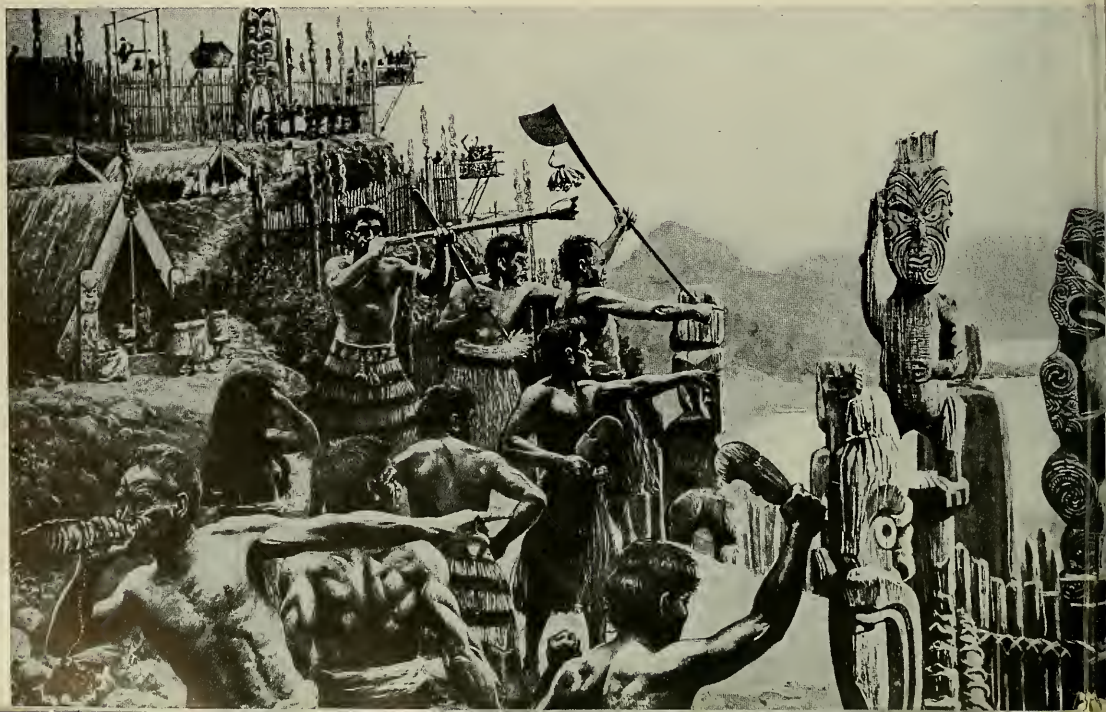
THE FIRST GOOD MAP *of New Zealand, based on Captain Cook's discoveries and surveys. It clearly shows the main outlines of both North and South Islands and many of the now famous scenic features, such as the Southern Alps and the fiord country*

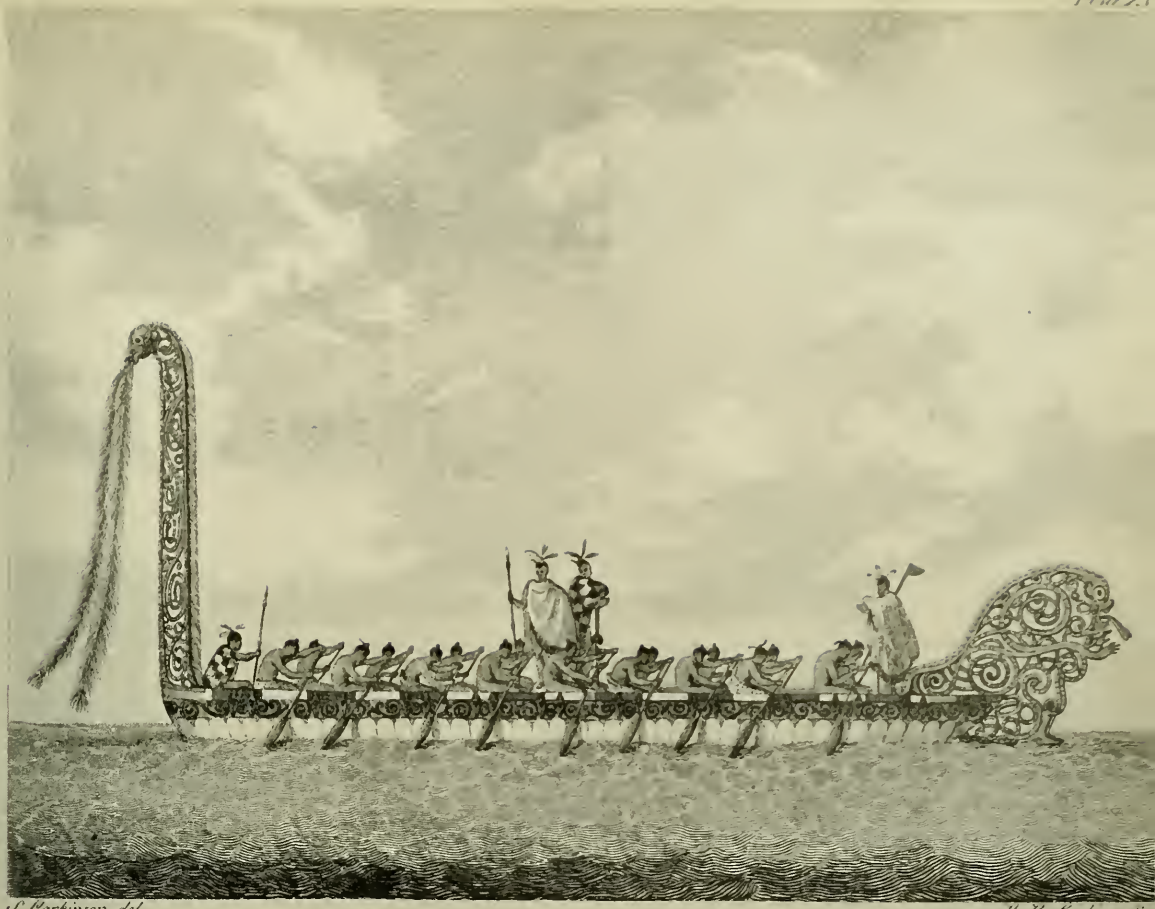
resources, especially as to timber and whaling, and made two proclamations of British possession, in 1769 and 1770.

After Captain Cook's visits, New Zealand was again left to itself until the first sealing party came to Dusky Sound in 1792.[3] Then came the timber-cutters, beginning in 1795, who made several small settlements. Early in the next century the deep-sea whalers, who were already well represented on the east coast of Australia, began to discover the advantages of New Zealand for the location of their shore stations. In the 1830's there were scores of these stations along the coasts of both North and South Islands. Escaped convicts from the penal colony of Sydney mingled with British and New England sailors in these lawless settlements, which were doubtless worse than the Merry Mount that aroused the ire of the Puritans in New England.[4]

In these places the Maoris were not slow to purchase strong drink and firearms and they soon acquired the white man's diseases. To any student of pioneer days in North America the horrible results of this situation need not be described in detail. Violent repercussions were set up among the Maori tribes, whose facilities for slaughtering each other were correspondingly increased, so that in a relatively few years the Maori population suffered severe losses, from which they never entirely recovered. Nor were the peaceful white settlers who began to come in shortly afterward spared the horrors of attack by the

(Below) THE ALARM. *In this painting of an old-time fortified village the Maoris have sighted a hostile party and the war trumpet is sounding the call to arms. The famous navigators Tasman and Cook both unhappily learned that the Maoris were fierce and effective fighters.* *From a painting by the late J. McDonald*





A War Canoe, of New Zealand.

fierce Maori warriors, who had what seemed to them excellent reasons for seeking revenge against the white despoilers of their land.

Into this world of sin and wretchedness the missionary Samuel Marsden in 1814 first brought the Christian religion. To the missionary many of the Maori ways were revolting and devilish. To the Maori warrior, on the other hand, the meed of successful battle was a great feast at the expense of the slain. To the missionary the natives' all-pervasive system of *tapu* [it is sacred, it is prohibited] must have appeared like a jungle of superstition. To the Maori all the ills of life arose from someone's neglect to perform his plain duty and obligation to observe every *tapu* strictly and conscientiously. Here was a conflict of ideologies between which there was at first no compromise. Many Maoris accepted Christianity and attended the missionary schools; on the other hand, many chiefs and priests opposed the curtailment of their privileges and prerogatives and the wiping out of the traditions that had guided them.

Meanwhile the encroachment of the whites upon the Maori lands bred repeated outbreaks, revolts and massacres, the last occurring as late as 1870. However, as early as 1840, Captain Hobson induced 46 paramount chiefs of the Maoris to assemble at the Bay of Islands, North Island, and to sign the famous Treaty of Waitangi, acknowledging the sovereignty of Queen Victoria. In this year also 500 settlers arrived from England and founded the city of Wellington, an event which is now being celebrated in the New Zealand Centennial in that city.

The British soldiers who fought the Maoris in the old days formed a high opinion of their valor, fortitude and resourcefulness. To the Maori, the "very parfit gentil knight" was he who, after many taunts and violent gestures, would rush in at his opponent and thrust and hack with a short sword-club made of polished greenstone, bone, or wood. Nevertheless it should not be thought that the Maori warrior merely laid about him with the indiscriminate zeal that is celebrated in the old Irish rule about fighting at Donnybrook Fair: "Wherever ye see a head, hit it." The absence of shields and body armor and the prevalence of threatening grimaces and gestures imply a variable period of feinting and bluffing, attack and retreat, with several clashes before the final *coup de grâce* was delivered. And the existence of

slavery among the Maoris suggests that by no means every warrior preferred death to shame. Possibly there were face-saving excuses in which the fault could be put upon the gods.

The praise of British officers was also paid to the Maoris for their knowledge and skill in fortifying their hillside citadels against surprise and mass attack. But, as so often happens in warfare, there was an "Achilles' heel" or weak spot in this system. "Impregnable as these fortifications may have seemed to direct attack," writes Gilbert Archey,[5] "they were frequently reduced by long, bitter siege or by daring stratagem and resourceful subterfuge. Garrisons in dire straits for food have even been known to barter their children for food; but the chief defect of the Maori *pa* [citadel] was water storage, which was well-nigh inevitable on a hilltop, and desperate sorties and stealthy night excursions were made to nearby stream or swamp."

Doubtless no small measure of technical skill and industry was necessary for the Maoris to make and to use effectively the numerous artifacts of war and peace in stone, bone, wood and other materials, which are so beautifully displayed in the Maori sections of the New Zealand museums, especially at the Auckland War Memorial Museum. Take, for example, the *hoeroa,* which is at first sight a rather unimpressive-looking staff of whale's bone, long, flat and somewhat twisted. But one end is beautifully carved with a spiral design, and there is a perforation apparently for a thong. The curator explained to us that when the foe was retreating, the embattled warrior is supposed to have quickly swung this club or staff around his head, holding it by the cord and suddenly releasing it. Presumably it acted somewhat like an Australian throwing-stick and may have whirled through the air and knocked down the fleeing foe. One can well imagine, however, the skill it would require to produce a properly balanced staff and the equal skill and patience required to make it fly in the right direction and hit a rapidly moving target.

According to Archey, "the bow and arrow, though known throughout Polynesia, were never used in fighting. . . ."[5] Hence the absence of the bow and arrow among the Maoris must be reckoned as another of their older Polynesian characteristics.

At every stage of his life the Maori must have felt beset and hedged in on all sides by a watchful, jealous and capricious lot of divinities, to say nothing of their special representatives of the priestly class. A Maori's education, which was ultimately controlled by the priestly schools,[6] required him to remember innumerable "don'ts" or rather rules, which implied "don't do so and so, or else. . . ." Then there was perhaps an equal number of recommendations what to do in case such and such a *tapu* had unhappily been violated, and how to invoke the power of the gods to help in the present situation. Just as in ancient Babylon or Rome one consulted the local soothsayer, or in medieval times one sought the nearest astrologer, so in New Zealand the chief had recourse to the priests who performed the appropriate rites and sacrifices to induce favorable results of any enterprise in hand, whether building a new house or snaring birds in the forest or starting out on a mission of vengeance.

In spite of the unscientific character of this system of regulating the affairs of life, it did give the Maori something to look to in time of trouble, and by curbing violation of rights within the social unit it made social and family cooperation possible.

Nor were the artistic abilities of the Maori by any means suppressed by the system of *tapu,* although doubtless directed thereby into certain channels. The most conspicuous examples of Maori art are the huge carved wooden *tiki* in the old Maori villages. These great blood-red totem posts are covered with grotesque human figures, presumably commemorating warrior ancestors or the patron war god. From their enormous owl-like faces their big tongues stick out in ugly defiance, while their fixed and gleaming eyes seem to say "This means YOU!" Their three-pronged hands

RELIGION IN MAORI ART. *Conspicuous examples are the* tiki (left) *blood-red totem posts, which presumably commemorate warrior ancestors or patron gods. Note the protruding tongue, a favorite symbol intended to inspire fear, and the characteristic three-fingered hands. These carved wooden posts, with their gleaming eyes and terrifying owl-like countenances, were customarily placed at each side of the house, as shown below*

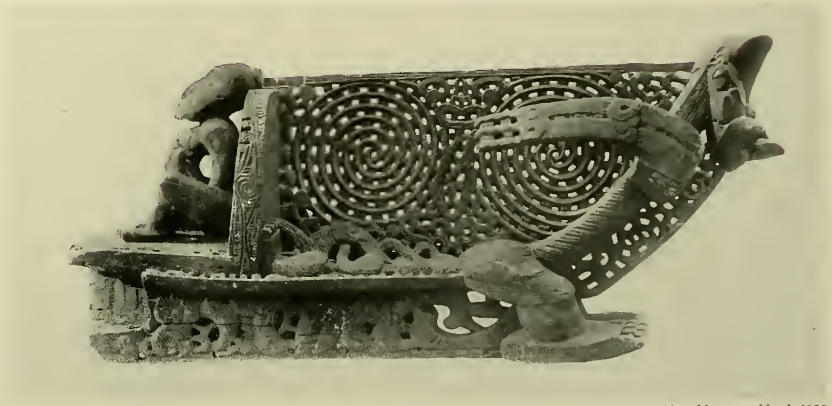
are laid contentedly across their swollen bellies—a gesture of repletion that was doubtless equally significant to friend and foe. Elaborate double spirals in relief cover the foreheads, cheeks, lips, shoulders, hips and thighs.

In North Island the large double spiral ornament runs riot over the doorway carvings of the meeting-houses and food stores of the chiefs and on the high sternposts of certain war canoes; it is also tattooed with infinite pains (to the tattooed one) upon the warrior's face.

Did the Maoris of North Island invent this spiral ornamentation during the long centuries of their residence in New Zealand? Or did their ancestors derive it from the curvilinear patterns, spirals and bird designs of New Guinea, Borneo and the northern Solomon Islands? The question is of more than local interest for it is connected with the larger problem of the racial and geographic origin of the Maoris themselves. It has been held[7] that the first settlers of New Zealand brought in decorative designs that were derived from the idea of a bird-headed man, which

(Below) ROUND TO FLAT: *a series showing the evolution of Maori art from a figure carved in the round to a flat slab in low relief. The fifth drawing shows extreme stylization in a contorted stance suggesting movement and vigor*

After Gilbert Archey

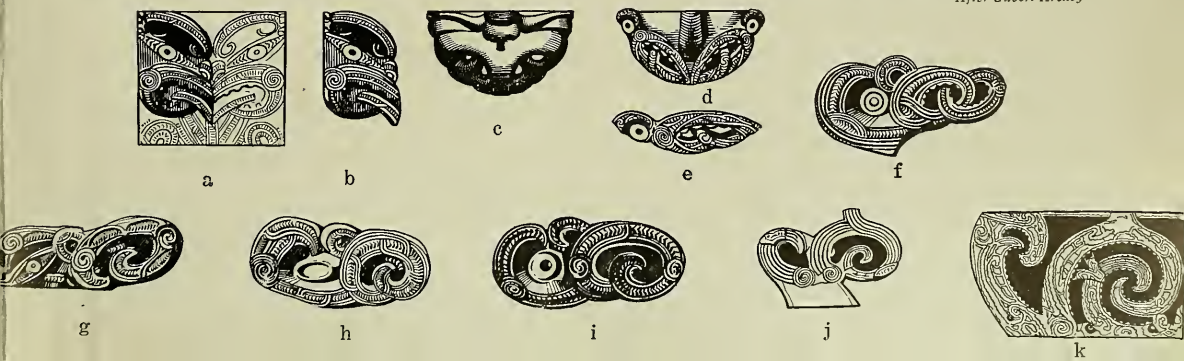


After Margaret Mead, 1928

DOUBLE SPIRALS *on canoe prow: a* motif *common in carvings and facial tattooing.*

EVOLUTION OF DOUBLE SPIRAL. *The supposed "bird-headed man" (b), common in Maori art, is derived from half a human face, as shown in (a); (c) and (d) are decorative human faces, while the beak-like mouth (e) is half of (d). The characteristic double spiral of Maori art (f-k) is derived from the interlocking lips of opposed faces*

After Gilbert Archey



occurs among the Melanesians and which may have eventually been carried out into the Pacific by negroid peoples from southeastern Asia. On the other hand, Doctor Archey[5] maintains that the double spirals have been derived from the prolongation and interlocking of the lips of opposed faces with protruding lips and tongue, and he presents some striking intermediate stages to prove the connection between the two extremes. After extensive comparisons it seems to him highly probable that the extreme prominence of the spiral was a local development in New Zealand and that the early phases of Maori art were brought into New Zealand by Polynesians who carried in their blood a certain strain of negroid Melanesian derivation and in their traditions some traces of Melanesian culture.

In certain districts in New Zealand the spiral scrolls are found in association with rows of, to us, comical little human figures. In far-off Rarotonga of the Cook Islands[3] similar little human figures, also in alternating front and side views, were applied on a genealogy staff to indicate a succession of generations, and the Maoris themselves kept track of successive generations by carving projections on a long bar.

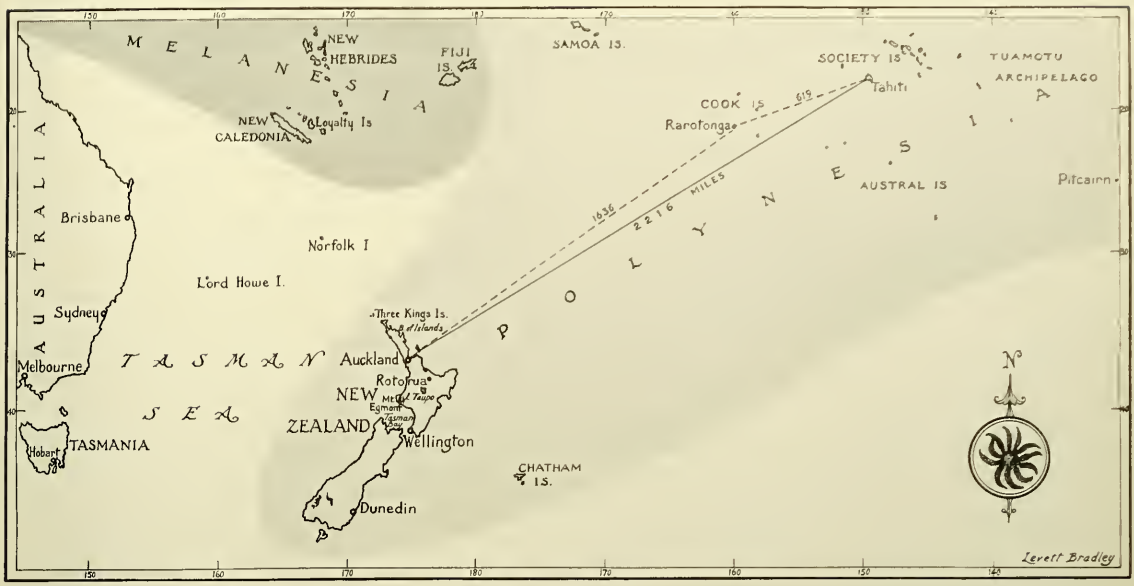
Captain Cook, who reached New Zealand by way of eastern Polynesia, clearly recognized that the Maoris were outliers of that race, and one of his crew, a Tahitian, could readily understand the Maori language as a kind of dialect of his own tongue.[2] Subsequently the comparative study of languages[8] has shown that the Maori tongue was closely akin to those of central Polynesia, and while modern anthropologists have proved that in many cases the possession by two peoples of a common language is not reliable evidence of equally close blood relationship, yet in this case the evidence clearly suggests that the language of the Maoris was brought to New Zealand by a people that came from central Polynesia. From the side of ethnology it is abundantly shown that these immigrants also brought in to New Zealand a religion, a social organization and a material culture which were already completely Polynesian but which underwent marked changes during their long period of isolation in New Zealand.

The Maoris themselves claim to be descended from people who set forth about 23 generations ago, about 1325-50 A. D., in "the fleet" of canoes, starting from "Hawaiki,"[9] which the anthropologists interpret as probably Tahiti. The name of each of these canoes (which were really great double canoes with a deck and a sail) is famous in song and story; no descendant of the Mayflower folk could be more particular than the Maoris are about the names and sequence of the successive generations of ancestors. Again, archaeolog-

"WHAT SORT OF FOLK ARE THE MAORIS OF 1940?" *The three Maori maidens below answer the author's question. The present-day Maoris do not bear out earlier prophecies that they would speedily become extinct. With their own far-seeing leaders, the Maoris are trying to adapt their cultural traditions to modern life*

Photograph by the Michael Lerner Expedition

According to Maori tradition, the first of their race to reach New Zealand was Kupe the Discoverer (about 950 A. D.). "The fleet" of canoes brought their ancestors around 1350, a voyage as famous in song and story as that of our own Mayflower. Maori language and culture support this story of their origin



ical investigation of ancient village sites, the results of which were shown to me in the Museum at Dunedin by Dr. H. D. Skinner, proves that in earlier times the people made stone adzes which closely resemble those of the Tahitians, that the peculiar Tahitian hook for bonitos, originally made of pearl shell, was copied by the early Maoris in stone,[10] and that the double canoe used by the Maoris until about 1840 was of central Polynesian type.

The skulls of certain "Moriori," who were the native inhabitants of the Chatham Islands, have been compared with those of the New Zealand Maoris on the one hand and of various Polynesian types on the other.[10] These people may have represented an earlier emigration from central Polynesia that preceded the Maoris, but at Dunedin Doctor Skinner showed me several Moriori skulls which were as like Maori skulls as different individual skulls could well be.

So on all sides the evidence of science is that the Maoris were Polynesians and that their ancestors came from eastern Polynesia about six centuries ago. Even the Maruiwi, or legendary Pre-Maori inhabitants of New Zealand, are now regarded as probably of the same general derivation.[8]

According to Maori traditions[9] the first of their race to reach New Zealand was Kupe the Discoverer, a bold Tahitian chief with a firm belief in himself as a navigator, who is dated as of about the year 950 A.D. On the great circle joining Auckland, New Zealand, with Tahiti, the distance is 2,216 miles, but allowing for tacking and other factors we might estimate the effective distance as being nearer 3,000 miles. Without going into elaborate calculations as to how many gourds of water and how many strings of dried fish, how many yams, etc., Kupe would have to carry, the answer to us is, *solvitur ambulando*—he did it—with his fast sailing double canoes and his crew of stout paddlers. Or even if the Kupe and Toi stories are partly mythical, the fleet mentioned above in 1325-50 covered the distance from Tahiti or, as some hold, from Rarotonga, which is several hundred miles nearer, and doubtless at different times brought over enough settlers to start many continuing tribes, each of which kept the name of the particular canoe which had carried their own ancestors.

When we consider with what great difficulty the English themselves planted and maintained colonies in New England and in New Zealand, the achievement of the Maori colonizers becomes all the more remarkable. It seems to indicate wise planning, a gift for adapting themselves to a wholly new environment and no little ingenuity in devising new types of implements, houses, clothing, and the like. For example, when the early Maori settlers arrived in New Zealand, they are believed to have brought with them some of the paper mulberry trees, which they intended to plant so that they could continue to make *tapa* or paper cloth from the inner bark. Such at least is the inference from the fact that Captain Cook saw a few of these trees,[5] but in a stunted condition, at the Bay of Islands. But apparently the trees did not flourish in New Zealand and although a little *tapa* was made for ornamental purposes, a warmer and more waterproof type of clothing had to be devised. Since according to the evidence the Polynesians were ignorant of loom-weaving and at the same time excelled in basket-making, the Maori women evolved a type of plaiting called "finger weaving," using the

fibre of the so-called native flax *(Phormium tenax)*, from which a close-meshed fabric was produced that was the basis of their garments.[11] Into this base were fastened short overlapping pieces of flax, which served as a kind of thatch to throw off the rain.

Again, when the Maoris came to New Zealand they found themselves in a country where gigantic trees abounded. They soon evolved a technique for making huge and beautiful war canoes out of single tree trunks.

On the side of food cultivation the Maoris were successful in developing socially cooperative methods in raising and harvesting the yam, gourd, sweet potato, which their ancestors had brought with them from central Polynesia.[5] The abundance of fish and bird life was matched by the ingenuity of Maori methods of fishing and fowling. In the virtual absence of native mammals, the only domesticated animal was the dog.

With all their enterprise, initiative and daring, however, the Maori populations rapidly declined during the first century or more of contact with the whites. No doubt infectious diseases and internecine wars were large factors. But it seems quite safe to affirm that the Maoris, no less than the Europeans, have always suffered from the misery brought on by the unbridled personal pride or "face" and ambition both of individual citizens and of their leaders; in these dark days even objectively minded scientists may be excused for insisting that the Maoris, as well as the rest of us, shall be saved, if at all, only through a more widespread practice of the Golden Rule and of the impartial findings of Truth and Justice.

Now what sort of folk are the Maoris of 1940? In the census of 1936 there were 81,774 persons classed as Maoris, the white population being 1,491,708.[12] In other words, there is about one Maori to every 18.2 white persons. Nevertheless, according to the same authority the Maori population more than doubled itself between 1896 and 1936, so that the Maoris have refused to verify earlier prophecies that they would speedily become extinct. But this is perhaps partly because the now dominant race practices, at least to a noticeable extent, the rule of "live and help live."

As we happened to see them in our recent visit to New Zealand, the Maoris seemed to be scarce in the big cities, to be widely scattered over the farms and ranches in the country and to be gathered into certain villages partly as entertainers of tourists, especially in the region of Rotorua. There we were received by Rangitiaria Ratema, a lady of high rank, who welcomed us to her home and showed us many beautiful capes and rugs made by the Maori women. Then she conducted us around the native village. This is situated in the midst of a thermal district and is well supplied with various steaming, bubbling and gurgling pools and miniature geysers, which the Maoris use as natural steamheaters, fireless cookers,

NATIVE NEW ZEALAND CLOTH-MAKING. *A Maori device resembling a loom but lacking the essential feature of a shuttle (After Margaret Mead)*

laundries, Turkish baths, etc. At that time, the young children were playing in one of the steaming pools but were very quiet when we came by.

In the evening the Rotorua men put on a most impressive war dance at their meetinghouse. In their warriors' costumes they advanced, retreated, stamped, whirled, and brandished their imaginary weapons, making terrific *tiki* faces, finally jumping up into the air and coming down on their knees as if their knees were made of wood and leather. The most terrifying part of their gyrations seemed to be intended to suggest to their enemies what they would shortly do to them. Next the women filed in and did the *poi* dance, whirling around light pith-balls attached to strings, snapping them to and fro with a charming rhythm, and singing a haunting refrain. Afterward they did the canoe dance to another song, also of European derivation. I was told later by a distinguished New Zealand composer that these songs were adapted from Moody and Sankey hymns brought in by the early missionaries; but though the European singsong themes were recognizable, they were now endowed with the exotic charm of native voices and tempo.

Our general impression of these particular Maoris

was that they were quite modern and somewhat sophisticated "play-actors" with an irrepressible sense of humor. On one occasion they added to the formal program a most comical, spontaneous and original interpretation of the "Lambeth walk." After this they changed their costumes, came out to meet the guests and then sauntered leisurely away or rode off on bicycles.

A more subdued and serious attitude toward life and its complex problems seemed to characterize the important enterprise of the Princess Te Puia of Ngaruawahia, who is engaged on a fairly large scale experiment in making her own people economically independent. On a large and fertile tract of land she is setting up a model dairy and farm run entirely by Maoris. After being most bounteously entertained in her home at dinner, with food steamed underground in the old Maori way, we were conducted to the village field and entertained with a fine display of dancing: a war dance by the men and the *poi* and

THE CANOE DANCE *of the Rotorua women celebrates the great part that the canoe has played in the stirring sea life of the race*

Photograph by the Michael Lerner Expedition

canoe dances by the women. An address in Maori was made by a Maori clergyman, who seemed to approve heartily of Princess Te Puia's attempt to conserve as much of Maori tradition and culture as is practicable under modern conditions. Afterward we were conducted to the shipyard along the river, where the Maoris put in their spare time in preparing a fleet of huge carved canoes for their aquatic celebrations.

On the part of the whites we found government officials, museum people, prominent newspaper editors and sportsmen expressing a high admiration and respect for the Maoris. This sentiment could not be more eloquently and convincingly expressed than in the following passages written by an eminent scientist:

"The Maori's last stand at Orakau, and his defiant reply to a suggestion of surrender are worthy of record among the annals of fortitude and heroism: *Ka whawhai tonu, ake, ake*—we will fight on forever and ever!

"The seasons have sped by; Orakau has been a peaceful countryside for many years; a proud native race has suffered many hardships through disease, loss of land, neglect and misunderstanding. Twenty years ago it was felt that the Maori was doomed to extinction, and, as a pure-blooded native race, perhaps he is. On the other hand, a deep stirring of national spirit among the Maori people is now manifest, and a strong revival of native customs, songs and arts is being joined to an economy and a social life that is merging more and more completely and successfully with the more powerful European influences.

"The Maori race will become united with the *pakeha* [foreigners] in a New Zealand nationality, and the best of Maori tradition, social usages, art and culture will make their contribution to our common civilization. So we may again use the final cry at Orakau, but paraphrasing it in translation as a motto for Maori and *pakeha* together: *Ka whawhai tonu, ake, ake*—together we shall strive forever and ever!"[5]

Four decades ago a young instructor in anthropology told his students that the "evolutionists" had had their day in anthropology and that all they had succeeded in doing was to bring confusion into the subject because they failed to distinguish between

WAR DANCE *by Rotorua men. Brandishing their weapons, they leaped into the air and landed as unconcernedly as if their knees were made of wood and leather*

Photograph by the Michael Lerner Expedition

physical evolution and cultural history. The development (evolution) of the human brain, for example, could be made out, at least in its broad outlines, tolerably well because there were quite a number of animals still surviving with their brains in different stages of development; it was necessary only to arrange these stages in the order of their increasing complexity and to compare them with the embryonic history of the brain of higher types; but the history of a cultural trait in a given locality was a matter which could be settled only by complete historical records of known dates and sequence; otherwise one would have only a lot of unverified guesses, and experience had shown that the real facts were often wholly unsuspected and unguessable.

We may accept these and similar cautions as good medicine and we may lose sight of them only at the peril of our reputations for reliability. Nevertheless, the anthropologists themselves, without any help whatever from outside "evolutionists" have gradually and cautiously worked out the evolution (begging their pardon) of both the Maori race and the Maori culture, and this to a student of the evolution of vertebrates abounds in facts and situations that seem to be only particular instances of well-known laws and principles of organic evolution.

On the physical side not even the Maoris themselves suppose that their ancestors were created on the spot in New Zealand; their own traditions happen to agree with the conclusions of the scientists that their ancestors came from central Polynesia. And the anthropologists after exhaustive research have concluded that the Maoris belong to the Polynesian subrace of the Mongoloid group of mankind *(Homo sapiens)*. More in detail, the Polynesian subrace is described by Professor Hooton[3] as "a tri-hybrid race of which the outstanding element is some 'Mediterranean' white stock, with a strong admixture of Mongoloid and a perceptible strain of either Melanesian or Negrito." So here we have the Maoris, like Americans or Englishmen, or, for that matter, like domestic cats or dogs or cattle, originating from the fusion of several older races or subraces.

But on the side of language, material culture and religion, dare we still apply the evolutionary point

MAKING *terrific* tiki *faces and savage gestures, these Maoris simulate the old war fury; but the girls in the back row do not take it seriously*

Photograph by the Michael Lerner Expedition

Photograph by the Michael Lerner Expedition

of view? In order that a new race, subspecies or species, may be developed, it is of the first importance that a relatively small group of the parent stock should become isolated and prevented from interbreeding with the main population. Surely the production of new dialects in a parent language is likewise due, at least in part, to separation or isolation of one sort or another. The long isolation of the Maoris in New Zealand is one reason why Toobaiah, Captain Cook's Tahitian sailor, found it difficult to understand the peculiar dialect of the Maoris, whose ancestors four centuries before that could speak just as pure Polynesian as he did. On the other hand, why was it that Toobaiah could understand them at all? And why did he presumably recognize that in spite of their somewhat peculiar ways they were after all long-lost kinsfolk? Surely there is at least a certain degree of analogy between the perpetuating principle of physical heredity and the conservative handing down of language and material culture by tradition.

When the Maori culture as a whole is compared with that of the ancestral Polynesian, it is seen that after they arrived in their new island home the Maoris found that they must give up some of their ancient ways and habits and develop new ones. For example, we have seen that the plants from which they made *tapa* cloth and which they had brought from their old homes, would not grow well in the new environment; so *tapa*-making had to be given up. Here then was the dropping out of a cultural trait, or rather a complex of cultural traits. And this is quite similar to the loss of organs or characters, which is well known to students of the evolution of plants or animals. But the Maoris were adaptable, ingenious

Photograph by the Michael Lerner Expedition

(At top of page) THE MEN OF NGARUAWAHIA *form a living pattern in a native war dance. Their Princess Te Puia arranged this impressive ceremony for the Michael Lerner Expedition*

REHEARSING *for the war play with two-handed clubs. The double fence of slender poles in the background would serve to check the onrush of attacking warriors*

people. They had brought with them the art of basket-making and they proceeded to adapt this art to the new purpose of plaiting flexible cloth, using the shredded tissue of the so-called native flax as their raw material. Here then, since basket-making was turned into cloth-making, is something analogous to the evolutionary principle of "change of function," and the use of the native flax instead of the *tapa* product is an example of the principle of *Ersatz* [sustitution], which is by no means known only to cheating merchants and blockaded governments.

Although such comparisons between the facts and principles of cultural history and the laws of physical evolution could be pursued much further, we must close with this thought. The Maoris certainly no less than other people regulated their conduct by a system of taboos or *don'ts* and many of these *don'ts* had as little relation to the acts forbidden as did the ringing of a bell to the expectation of food on the part of Pavlov's "conditioned" dog. Thus men and dogs govern their acts by a system of symbols or signs, with values determined by association. When the Maoris finally accepted European culture, they acquired a new set of symbols.

Our personal observations suggest that between the Maoris and the Europeans there will be a gradual revaluation of these ancient taboos and commandments and that the science of man is actively assisting in selecting the wheat from the chaff and in adapting the "best" parts of each culture to a new and useful living pattern.

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[3] *Handbook for New Zealand* (Wellington: Australian and New Zealand Association for the Advancement of Science, 1936).

[4] William John Dakin, *Whalemen Adventurers* (Australia, 1938).

[5] Gilbert Archey, "South Sea Folk," *Handbook of Maori and Oceanic Ethnology* (New Zealand: Auckland War Memorial Museum, 1937).

[6] Elsdon Best, *The Maori as He Was* (New Zealand Board of Science and Art Manual No. 4 [1924]).

[7] H. D. Skinner, 1924. Quoted by Gilbert Archey in "The Maori; History and Ethnology," *Handbook for New Zealand* (1936), p. 79.

[8] A. Neville J. Whymant, "Polynesian Languages." *Encyclopaedia Britannica* (14th ed., 1929), XVIII, 189, 190.

[9] Peter H. Buck (Te Rangi Hiroa), *Vikings of the Sunrise* (New York, 1938).

[10] H. D. Skinner, 1923. *The Moriaris of Chatham Islands* (Mem. Bishop Museum of Polynesian Ethnology and Natural History, 1923-1928), IX, 3-140.

[11] Margaret Mead, *The Maoris and Their Arts* (American Museum of Natural History Guide Leaflet No. 71 [1928]), pp. 27-33.

[12] E. P. Neale, "Outline of the Economic History of New Zealand," *Handbook for New Zealand* (Australian and New Zealand Association for the Advancement of Science, 1936), pp. 113-123.

[13] Earnest A. Hooton, *Up from the Ape* (New York, 1931), p. 520.

AT ROTORUA, *the Hollywood of New Zealand, the people still practice the old arts for the benefit of tourists. On the other hand, in the cities and on the farms the Maoris are playing their full part in the development of modern New Zealand civilization*

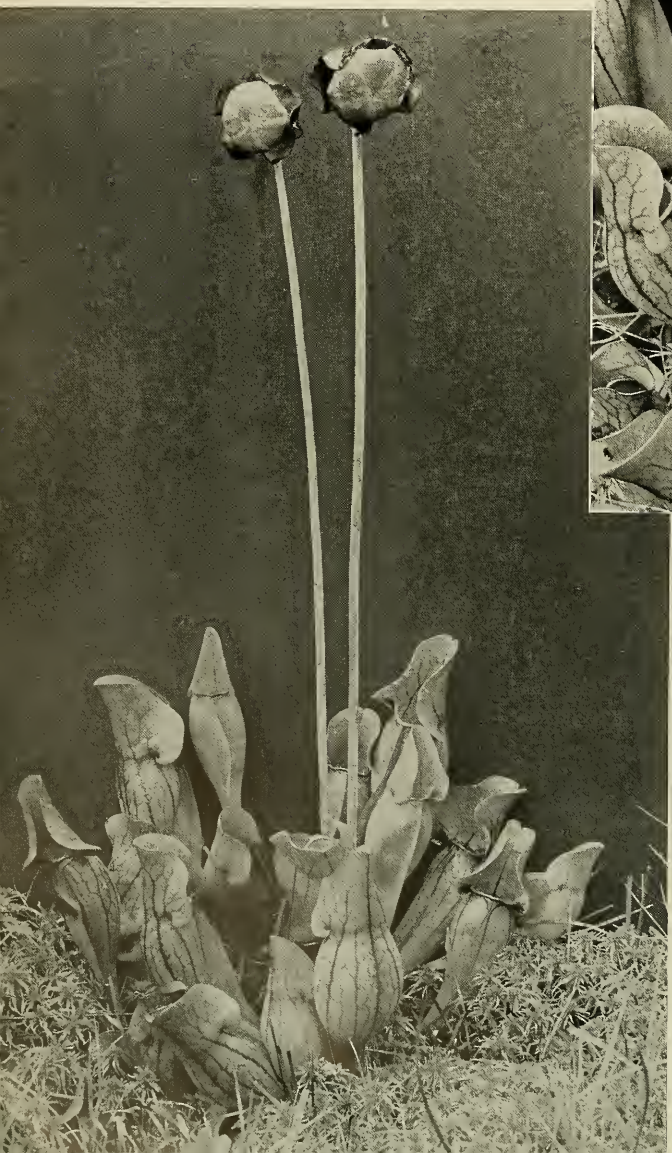
Courtesy of the New Zealand Government

THE TREACHEROUS PITCHER PLANT

By Devereux Butcher

Though moralists commonly extol the botanical world as Nature's only nonpredatory expression, plants boast some 400 species of meat eaters. These range over the earth, their growth probably being encouraged, if not brought about, by soils poor in nitrogen. Unable to secure this essential nutrient through normal channels, these plants may have taken up eating the nitrogenous insect protein as compensation. At any rate, their individual adaptations show Nature in a highly inventive mood.

Perhaps most familiar of the American forms are pitcher plants, of which this example *(Sarracenia purpurea* L.) is the only species growing north of Virginia. In contrast to their compatriot the rare Venus's-flytrap,* these plants do not snap shut on their victim. The leaf is shaped like a cream pitcher with a scalloped lip, and the inner structure is such that a secure trap is not needed. Merely natural curiosity leads the insect to examine the hollow cavern. Once falling from the edge into the water, the most active insect has but slim chance of getting out. The walls are not only steep but exceedingly smooth, and even if the wet and exhausted creature should manage to surmount this "slide zone" it would encounter a barrier of long, stiff hairs pointing downward. Dropping helpless into the pool, the victim drowns and slowly yields up the substances of its body, to be absorbed by the plant.



The flowers of this plant bear long petals, which in the accompanying photograph, have fallen off. The habit of the flowers to nod back and forth has given rise to the imaginative popular name "side-saddle plant." Another name is whippoorwill's-boots.

*See "Meat-eating Plant," Natural History Magazine, January, 1940.

THE BIRDMAN—*If you are born with the gift, a few practical pointers will save you much time on the road to one of the happiest professions a man or woman may follow*

By FRANK M. CHAPMAN
Curator of Birds
American Museum

EVERYONE who knows birds is interested in them and as our acquaintance widens, so our interest grows. They animate the world with their

> "Songs and forms and rhythmic flight,
> Their manners for the heart's delight."

They are living calendars; their comings and goings, their songs and calls mark the changing seasons. Four hundred years before Christ, Aristophanes wrote:

> "We give you the warning of seasons returning . . .
> You quit your cloak at the swallow's behest
> And in assurance of summer purchase a vest."

But the birdman's feeling for birds is not to be expressed by so mild a term as "interest." He enters the world with a heritage which inevitably makes him as different from the average man as is the "born" artist or musician.

He is the inspired bird lover. The bird world is *his* world; its inhabitants possess for him a mysterious fascination which increases in strength as he becomes more intimate with them.

To quote Aristophanes again, birds for him are, "All in all . . ." his "best benefactors and early instructors." He is obsessed by his passion for them; his thoughts, his words, his deeds; his desires and ambitions; his dreams of the future are all determined by the inheritance which, for him, makes birds the most significant of living things.

Whence comes this gift of the gods which is the birdman's precious possession? I have called it a heritage, for unquestionably he is born with it. Rarely its development may be deferred, but as a rule, under favorable conditions, it is manifested at an early age.

In vain his puzzled parents search their ancestral records for some trace of the birdman's origin. They find nothing; he apparently is the first of his kind in the family tree—a "sport" or mutant. But, in my belief, they would discover the beginnings of their son's peculiar traits if their genealogy were complete. I should look in its earlier pages when birds first appealed to the imagination of primitive man. No other form of life exercised so strong an influence on his lore and his legends, his rites and ceremonials, his totems and symbols, his costumes in peace and insignia in war. Bird migration, still a mystery to us, was to the savage among the most impressive of seasonal phenomena. Bird songs and calls profoundly affected his beliefs and superstitions. Here then we may look for the origin of that universal interest in birds that today makes the stork a bearer of babes, the eagle a symbol of war, the dove a messenger of peace, and gives to all of us relations with "little birds" that tell us things we are not supposed to know.

A rare heritage

Here, I believe, we may also find the birthplace of the birdman, exceptional product of lines of descent which through countless generations have crossed and recrossed adding to and bearing forward the heritage, possession of which distinguishes him among his fellows. Normally, this inherent love of birds is manifested at an early age and nowadays abundant opportunity is usually offered for its development. But 50 years ago, when popular bird books were even rarer than ornithologists, the potential birdman may never have realized the value of his vague longing for knowledge of the creatures which possessed for him a special attraction. Instinctively he was aware of their personalities and learned to recognize some of their calls and songs. I knew the wood thrush's voice long before I knew the bird. It gave expression to the spirit of the woods and found its place in my memory and affections. But who could give names to these impressions?

Egg-collecting and trading was the nearest approach to anything like bird study and the egg-dealers' catalogues served as a check list of birds' names. Even this humble beginning sometimes carried one far; but more often it was merely a hobby, largely inspired by the spirit of competition and ended with one's school days.

Because I have dwelt only on the birdman and his needs, let it not be thought that woman does not also receive this bequest from unknown ancestors. Circumstances may rarely favor its development professionally, but always it is an inspiring bond between her and Nature, and her enthusiastic pursuit of birdlore often rivals that of her brother.

It was not until the founding of the American Ornithologists' Union in 1884 that scattered bird lovers throughout the country found a flag under which they could rally. One of the Union's early moves was to send out a call through the press, particularly sportsmen's journals, for volunteers to observe the migration of birds and report to the Union's Chief of their "Division." This at once placed the amateur in touch with the professional and "Citizen Bird" now rapidly came into his own.

The A.O.U. soon gave birth to the Audubon movement which has not only protected birds but promoted bird study. Realizing that it was difficult to arouse a lasting interest merely in birds' names, it inaugurated a campaign of education, assured that once the bird was known, it would become its own best advocate. Millions of children have been enrolled in its Junior Bird Clubs.

Obviously sources of assistance for the birdman have greatly increased; but so have the birdmen. The "plant" that 50 years ago might have died for lack of encouragement, now shoots upward toward blossom and fruit. In this growth museums play a leading part. They now educate not only through their exhibition halls but through personal contact of curators with seekers for information.

First signs of a birdman

But whatever the birdman's origin, here he is, an undeniable fact, and for him, as well as for his parents, life is still a problem. My earliest contact with the potential birdman is made through his parents. Finally impressed by the strength and seriousness of their boy's interest in birds, they appeal to the professional ornithologist for advice in meeting a situation which they are wholly unprepared to understand. They may admit the attractiveness of birds, they may sympathize with a boy's love of outdoor life, but the possibilities of bird study as a life work are utterly unknown to them.

Fortunate is the boy whose parents appreciate the vital importance of desires which, properly developed, may determine their son's career. Usually they write for advice but when possible they bring their "duckling" offspring to the Museum. Within the week a mother and her boy of fourteen came from Philadelphia solely to discuss his future. I know from experience what this great event meant to the boy. It might be imagined that he would approach it shyly or with hesitation. Not at all; he was eager for it; he seemed to realize that he was entering a world where for the first time in his life he would not have to explain himself. Community of interests placed us both at ease. A question or two opened the floodgates of long-impounded observations of birds and books. At once we discovered that we spoke the same language, while the parent regarded a before unknown son with mixed surprise and pride and willingly took her place on the side lines.

When next I meet the would-be ornithologist he is usually of preparatory school age and deeply concerned about the succeeding steps in his career. What college offers courses in ornithology; what does the future hold for him? At the completion of his college course his second question becomes more definite and urgent and is frequently accompanied by an application for a position in the Museum.

Need of training

Besides these more stereotyped cases there are the boys who, animated by their love of birds and possibly also by the desire to hunt, and ignorant of the requirements of the science of ornithology, want to begin their professional careers with no other equipment than a single-minded devotion to the study of their local bird life. The importance of acquiring a general, as well as special, education is unknown to them. Frequently they are unable to meet the costs of proper training and, in most cases, are not sufficiently impressed by its need to determine to secure it.

Rarely the birdman does not become aware of his heritage until he has reached the years of manhood.

Weir Mitchell once remarked that Benjamin Franklin was born in Philadelphia at the age of seventeen. So, too, the birdman may not be born until he enters manhood. It may be claimed that such cases are merely the response to a late discovery of the charms of birds, rather than the deferred development of an inherent interest in them. But the symptoms exhibited bespeak a long, if unrecognized, existence rather than a suddenly acquired interest. The late Lord Grey did not become fully aware of the existence of birds until he was adult. But one has only to read his *The Charm of Birds* to learn the depth of his affection for them and what an important part they played in his later life. Perhaps it was his absorption in fly-fishing that claimed exclusively his early attention.

One of the leading, most enthusiastic students of bird song in this country did not leave the Stock Exchange until his late thirties, and there are instances of even older men who suddenly have become bird conscious.

The born bird lover, whose claims to an inheritance from an unknown past are unquestionable, is always a bird lover. Circumstances may dim the fires of his devotion to birds, but they are only banked, not extinguished, and in good time will break into unquenchable flame again.

Theodore Roosevelt was born a birdman. At the age of fourteen he had founded "The Roosevelt Museum" and planned to devote his life to the study of nature; but like Lord Grey, though he could not close his ears to the call of his country, he never lost his love of birds.

I know a man, now in his sixties, who while an undergraduate in an Eastern college went to the tropics to collect birds during a summer vacation. Expose the born bird lover to the fascinations of tropical bird life and he contracts an incurable ornithological fever. It can be allayed only by a return to its source. So after graduation this young man went back to the tropics determined to spend the next three years in making a fortune and then to devote the remainder of his life to bird study. The three years stretched to nearly 40, but when eventually fortune brought freedom, the desire for bird study returned unabated and he is now monographing the bird life of the land of his adoption. There is no question of the genuineness of his heritage.

So, in outline, I have sketched the possible birdman as I have learned to know him. For the present we may well leave our younger heirs to the kingdom of birds in the care of their sympathetic parents. We are here concerned with those boys who are old enough to speak for themselves. Most of them I meet by mail but whenever possible I urge the personal contact which means so much more to us both.

With the boy at my side I can judge far more satisfactorily of his chances of success than if I know him only by correspondence. Personality, appearance, address, even voice, are important factors in the professional birdman's equipment. As he states his hopes and aims his very tone gives a measure of his seriousness. These boys are at the age when the romance of a naturalist's life makes its strongest appeal, and it is as difficult for them, as it sometimes is for me, to distinguish between their ambition to become trained ornithologists and their desire to join expeditions to strange lands where they will see forms of life which they have known only in books and zoos, and where every day may bring new adventures.

Only if you can't help it

To these boys I talk not of camping, collecting and hunting but of the education they must acquire if they expect to win a place in the front rank of their proposed profession, where alone success is to be found. I am intentionally discouraging. To one and all my stock advice is "do not be an ornithologist if you can help it," knowing well that if they are real birdmen they cannot help it and nothing will turn them from their course. They are Thoreau's man in earnest. "What a wedge, what a beetle, what a catapult," he wrote, "is a man in earnest. What force can withstand him?"

The work of the modern ornithologist varies with the character of his post. It may be technical as well as cultural and include research as well as teaching. It may be in the field as well as study. He cannot choose but should be prepared for whatever opening offers. This is not the place to present a detailed curriculum. A broad general education should emphasize languages and literature with practice in methods of presentation, orally and in writing.

To his courses in biology he should add at least enough geology and meteorology to acquaint him with sources and thus enable him to get more.

As we learn the importance of maintaining balanced conditions in Nature, increasing attention is being paid to conservation and ecology in their broadest relations, not only to the earth, but to its life: Doubtless, courses in these subjects will be found in his special study of ornithology. We are on the frontiers of learning the conditions that exist between ourselves and our environment. Every naturalist, and particularly every field man, will realize the necessity for keeping abreast of the times in this subject.

Branches of bird study

With this groundwork, our birdman is now prepared to enter his special field. The exact nature of his studies here will doubtless be determined by his desire to become a taxonomist, behaviorist, experimentalist or conservationist. I will not attempt to give advice here. He will receive it from trained instructors whose experience tells them how to prepare him for the future.

He should not pay too much attention to questions of identification. That type of information will come with experience as it is needed. Now is his opportunity to study subjects not so readily learned from books as from teachers. The major aspects of classification, the technique of nomenclature, anatomy, physiology, psychology, the bird's senses, its special characteristics of flight and migration, its feathers, their color and structure, their molt and distribution on the bird's body—these and other phases of the bird and its life should claim his attention.

We may pass now to the day when, with diploma and degree as credentials, he enters the world of professional ornithologists frankly in search of a job.

In my opinion the time is not distant when the value of the birdman to the community will be recognized and he will be accorded a place in our educational and economic systems. At present the ready-made demand for his services is far below the supply.

It would be useless for him to advertise, and he will find that he has no rating in employment bureaus. But he will find the equivalent of an employment bureau in the Civil Service Commission at Washington. It would be a good plan to write the Commission for information in regard to junior biologist examinations long before he is ready to take them. The information secured will acquaint him with the requirements to be met before he can be enrolled as available for a governmental post. In due time he can learn the date when examinations will be held.

The fellowship of ornithologists

At the earliest possible date he should join the American Ornithologists' Union—the A. O. U. as it is more familiarly called. This is not a branch of the A. F. of L. or C. I. O. but the organization of ornithologists to which I have before referred. Possibly he may find it more convenient to affiliate himself with the Wilson Club of the Mississippi Valley, or the Cooper Club of the Pacific Coast, both, in effect, local A. O. U's. If possible he should attend the annual meeting of one of these organizations. Thus he may enter the world of active ornithologists, learn the trend of current research, meet the men who are conducting it and otherwise form connections which may prove to be of both practical and scientific value. I could mention the names of more than one professional ornithologist whose future was decided at an A. O. U. meeting.

These preliminary moves may be made before his training is completed. When finally prepared to apply for a position his thoughts and desires will naturally turn first to museums. There alone he will find the ideal opportunity to study birds in field and laboratory, of which he has dreamed. But museums with bird departments are limited in number. Moreover, the natural history museum is one of the first institutions to feel the pinch of a depression. Nevertheless, he should place himself, with a statement of his equipment, on file with the curator of every promising bird department.

The growing activity in the broad field of conservation and "game management," the need for naturalists in federal parks and other branches of government service offers attractive possibilities for outdoor work and ecological studies. The day of the old type "game warden," to whom the living world was divided into "Game" and "Vermin," has passed and he is being replaced by the man trained to study the relations of an animal to its environment. One may learn of the possibilities in these branches of applied ornithology through the Civil Service examinations to which I have just referred.

As a teacher of natural science or biology the birdman may emphasize the importance of birds and thus create an ornithological atmosphere in which his own special interests may thrive, while the long summer vacations give him time for field work.

Besides these more definite, standard openings there is always to be considered the life of the ornithological free-lance. Wilson and Audubon were the first American free-lance birdmen. With essentially no training and a small audience both achieved success.

Of the two I should name Wilson as more nearly meeting the requirements of the bird student who became an ornithologist because he was unable to be anything else.

Audubon was not only a born bird student but he was also a bird painter. His unquenchable love of birds found expression primarily in his ability to portray them as they never had been portrayed before. But no one ever called Wilson a bird artist. He taught himself to draw and to engrave because he felt that his book needed illustrations. To put it briefly: Audubon's text was accessory to his drawings, while Wilson's drawings were accessory to his text. Moreover, Audubon had Wilson as a guide and, let it never be forgotten, he had also Lucy Audubon. Wilson had no one. But without regard to equipment or aid both succeeded because they created something that the world wanted.

The birdman and his public

Where Wilson and Audubon wrote for thousands, the present-day ornithologist addresses millions. Whether he can supply them with the kind of birdlore they enjoy depends upon his ability to interpret their wants and his skill in meeting them. He must now be not only the bird student, who can speak with authority on the innumerable phases of his calling, but he should be the author who, to accuracy of statement, adds charm of presentation. The lecture platform should be the pulpit from which he preaches the gospel of the bird lover. The camera may be the brush and palette with which he secures illustration for his articles and books as well as for his addresses. With color film he may adequately portray not only the bird, but also its haunts. His world is as wide as he can make it. His audience will be limited only by his success in arousing its attention. At the best his material reward will be small, but he will find ever-increasing joy in a world which only the elect may enter. Common interests will keep him in age-defying association with his colleagues, and the years will bring him not alone satisfaction in his own achievements but the knowledge that he has introduced others to the potential bird within them.

LAYING A GHOST IN SUMATRA

For the first time, the camera records the departure of a Batak soul as a mixed audience of living men and unseen spirits looks on

By S. DILLON RIPLEY

A PHOTOGRAPHIC STORY reproduced through the courtesy of Dr. P. Voorhoeve and Mr. R. H. Volbeda, who assembled the material for museums in Sumatra and Leiden

GHOSTS WALK in broad daylight among the Bataks of Sumatra. A man of wealth and influence has died before his time, and the witch doctor or *guru* has visited the family to notify them that the spirit of the deceased has requested a ceremony. The witch doctor receives pay for the construction of the ghostly effigy or *bedjan*, and proceeds to carve it, while the family prepares for the three-day preliminary feast. Then comes the music of gong, drum and flute—slow, drowsy and hypnotic. The effigy *(left)* is stylized, and its routine movements are prescribed by custom and controlled by the witch doctor. Yet to the Bataks, effigy and dance become very real when the ghost of the dead man stalks the village to take ceremonial leave of this world

(Below) THE "BACKSTAGE" of a ghost. From the *guru's* first move, the dance is marvelously compelling. At right is shown the clever drapery that hides the person of the *guru*

The "ghost," taking up a basket containing clay models of food for his heavenly journey, begs the gods to look favorably on his family

(Left) A WOMAN is appointed to join the ghost in a solemn ritualized dance, which reaches its climax *(right)* in a last, lingering embrace. This signifies the ghost's farewell to manhood

(Below) LURKING unobtrusively in the rear, the *guru* skillfully manipulates the long, gracefully curved fingers which are a product of his own handiwork. The ghost wears a particolored turban and a red jacket. Both are ceremonial garments

(Right) RAISING his hands in renunciation, the ghost bids a sad adieu to his personal possessions which are arranged in front of his former home. Note the *guru's* careful guidance of the posture. In addition to his gifts as artist and dancer, the *guru* also has the power to wish curses on your worst enemy—for a price

(Right) At the door of his earthly home he casts a last long look at the interior, careful not to call down the wrath of the gods by entering

(Left) At the thought of all these things he will never see again, the ghost, like a tragedian in the grand manner, wraps his cloak around him and weeps

(Right) As the dance draws to a close, he lifts off his turban and, weeping piteously, places it in the basket containing his ceremonial food and utensils. Last act but one of this "strange eventful history" calls for the *guru (below)* to step upon the stage and put out the ghost's eyes

Blinded so that he may never find his way back, the effigy ghost and his basket are rushed to the river by the fastest boys in the village. Firecrackers explode everywhere and another ghost is laid in Sumatra

THE HOUDINI OF THE

By WILLIS J. GERTSCH
Associate Curator of Spiders
American Museum of Natural History

The trap-door spider startles the onlooker when it performs its disappearing act, and the door to the miniature dugout in which it hides is difficult for even man to pry open

ONE MOMENT you see it, the next it is gone. The spider seems to have been swallowed up by the earth without leaving a sign on the surface to show where it has gone. Tens of thousands of years before soldiers on the Western Front were constructing dugouts and pillboxes, the trap-door spiders had learned to make excellent ones for themselves. Not only are these subterranean fortresses impregnable to most enemies, but the trap-door lid often fits so perfectly as to make them practically gas proof. Man's attempts to hide his dugouts by grooming the soil and rearranging the plant covering are feeble efforts compared with those of the spider who is a master of camouflage.

Intensive hunting during the day may not lead to the discovery of the spider and its nest, for it is a most secretive creature. Sometimes at night, under the rays of the head lamp, it may be seen at the mouth of the burrow, supporting the trap door on its back; or it may be bold enough to venture a few inches away from the opening. When disturbed, it performs its surprising disappearing act with lightning quickness, leaving the would-be investigator at least momentarily confounded. It takes a keen eye and considerable experience to locate the door, which often blends so completely with the soil as to be virtually invisible.

Much of the adventure in the life of a trap-door spider is crowded into the first few days of freedom when the young spiderling, having deserted the protection of the maternal burrow, strikes out for itself or in company with its numerous brothers and sisters. It is in the early spring that the urge to move impels the babes to climb upon a promontory from which they will make their first, and probably their last, aerial flight.

"Ballooning" is a habit which is associated with spiders of all or nearly all families, and it is now well known that trap-door spiders, children of the earth

Photo by Herbert S. Ardell

NOW YOU SEE HIM: *Nature's master illusionist, the trap-door spider, waiting in ambush for his prey—*

for most of their life, are no exception to the rule. The young of *Pachylomerus* travel overland in single file in a group toward a sizable tree or other tall object, leaving behind them as the record of their march a narrow, silken band. Up the tree they go, often to a considerable height, and when all is in readiness they tilt up their abdomens, throw out silken threads to the breezes, and are wafted away.

How far they fly depends upon the air currents, which sometimes support them for many miles but ordinarily probably drop them to earth after a flight of only a few rods. Ballooning is interpreted as a protective habit, for the dispersion of the numerous progeny on the whims of the winds prevents a wholesale cannibalism and effects a more general distribution of the animals over suitable terrain.

Once the baby spider is again on the ground, the wanderlust deserts it and it digs a tiny burrow into the soil, comparable in all respects except size with that of the mother, and caps the opening with a hinged cover. For a digging instrument the true trap-door

SPIDER WORLD

Photo by Herbert S. Ardell

NOW YOU DON'T. *He vanishes beneath a skillfully camouflaged "secret panel" he has built in the earth*

spider is equipped with a comb-like rake of short, stout spines on the margins of the jaws. Using the silk from the spinnerets to bind the grains together, the spider carries bits of soil outside the burrow and deposits them at some distance from the opening. The walls of the tube are waterproofed with saliva and earth, so that the surface becomes smooth and firm, and are then lined with silk.

With the establishment of a domicile, the spider becomes antisocial, an individualist jealous of its tiny home, which it defends with glistening fangs. Its brothers and sisters, so recently tolerated as equals in the maternal burrow and as companions on the march to the ballooning tree, become fair prey to its jaws should they come within range.

When the growing spider outgrows its burrow, it enlarges it by cutting and scraping off bits of soil with the rake and carrying them away from the site. Rocks imbedded in the soil may oblige the spider to dig a new tunnel in a more favorable situation. It rarely deserts its burrow voluntarily. When it is forcibly removed, it will accept the unoccupied tunnel of another spider, remodeling it if necessary. During the growing period when the spider is remodeling and strengthening its closed tube, it is less subject to the attacks of marauding wasps which, in filling the food requirements for their offspring, pass up the smaller burrows with their inferior occupants in favor of mature or nearly mature prey.

Although spiders of many other families burrow, the trap-door spiders have far outstripped them in the excellence of their tunneling. They have become specialists who dig with better instruments, line with greater care, and are the originators of the intriguing practice of capping the burrows with a perfect lid. The trap door is not a unique accomplishment of these spiders, for it has been developed independently in several other groups, but the finished product of the trap-door spiders bespeaks a mastery not closely approached by emulators.

The typical burrow, a cylindrical tunnel in the earth which is completely lined with silk, is spacious enough in part of its length to allow the spider to reverse its position at will. Within its confines the spider will find a haven until life ends in insidious, violent, or natural death. What are the advantages of the burrow, which has become such a dominant element in the lives of these spiders? In the first place it is the property of a single, unsocial individual and can become, with the passage of time, more and more adequately coated with silk, more and more familiar in its every part, and thus increasingly acceptable to the spider. It is a retreat from the rays of the sun, the extreme heat of which is shunned by nocturnal and diurnal spiders as well. The hinged lid prevents rain and surface water from entering, thus keeping it dryer than situations on the surface. All of the burrowing spiders live more than a single year, some of them several years, so the tunnel is effective in tempering the extremes of inclement weather. During the hottest part of the summer, and strangely enough at a time when some parasitic wasps are present in their maximum number, the opening may be closed tightly with earth and silk. The tube beneath the surface is cooler during the summer heat and somewhat warmer during the extreme winter cold.

Relatively inconspicuous in any case, the burrow opening is often well hidden, and may be made even more difficult to discern through the efforts of the spider. Mosses, leaves, sticks, and other debris are placed to advantage on the lid and around the entrance, the result, to our eyes at least, hinting of cam-

ouflage. When in active use, the burrow can serve as an ambush from which the spider rushes out to seize its prey. And once an insect is caught, the nest becomes in many cases the dining room. At the proper season the burrow may become the mating chamber; and within its confines occur egg laying and cocooning. Later it is the home of the young spiderlings for some time after their emergence from the egg-sac.

The opening to the surface is the spider's only contact with the outside. Allowing the spider to be menaced only from one direction, the burrow can be defended either from the mouth or from within the tube by strong jaws. Above ground the trap-door spider's inferior sensory equipment would place it at a much greater disadvantage in combat with its specialized enemies.

While the demands for privacy have probably inspired the perfection of the underground castle of the trap-door spider, it is more intriguing to think of the domicile in terms of response to the ravages of some arch enemy. By far the most fearsome assailant of the animal is the spider wasp, a common name used in reference to various species of Pompilidae which are exclusively spider predators. Other enemies may wreak their toll in an insidious way and possibly destroy as many individuals as do the wasps, but the gleaming tyrant is a predator of the first magnitude, which in hand to hand struggle takes its toll of adult or large spiders.

The wasp, actively foraging over the soil and unerringly directed to the site by a sense not conditioned by previous experience, arrives at the trap door beneath which sits its prospective victim. Possibly informed of the presence of an intruder by its delicate tactile sense, the spider may be fully prepared to resist to the death. If unprepared, or if resistance is finally broken down, the spider may quickly find itself confronted by an enemy which has lifted the trap door or gnawed through it and entered the spacious burrow. The struggle that ensues is not a battle of giants. It is a very unequal one, from which the wasp almost always emerges the victor. Swift and sure in her movements, liberally endowed with fine sensory equipment, and armed with a deadly sting, the wasp faces a larger creature which, though at best advantage in the prepared battleground of the deeper recess of the burrow, is not a fair match. After a brief struggle during which the wasp paralyzes the spider with venom from its fiery sting, an egg is deposited on the abdomen, from which will hatch the voracious larva. Doomed to lie helpless while furnishing fresh food for the larva, virtually dead if not actually so, the once high spider finds its castle converted into a crypt. Its industrial skill has failed to make the burrow impregnable to its most formidable enemy.

It is not generally known that there are many different kinds of trap-door spiders in the United States, probably as many as 20 species, which differ to a considerable degree in general appearance and are often distinctive in habits. Most of the species are confined to the southern portions of our country. All of them close the opening to the burrow with some sort of lid; yet within the burrow itself may occur various innovations. Although it must be confessed that we know all too little about the habits of these secretive creatures, it is intriguing to try to interpret the burrows in terms of protection for the occupants.

The California trap-door spider, *Bothriocyrtum californicum,* the victim of the larval cyrtid fly in the article following this one, builds a thick door, made up of alternating layers of soil and silk and beveled to fit into the burrow opening, much as a cork fits into a bottle. The burrow, capped with the thick door, which is heavy enough to close of its own weight, is ordinarily a single tube. When menaced, the spider holds the door down with claws and fangs with surprising strength. Even man, with the aid of an instrument such as a knife blade or other tool, has great difficulty in forcing the "cork" door. Physical strength is a definite asset in the spider's efforts to keep its home inviolate.

On the other hand, the lid may be made up almost wholly of silk and lie loosely rather than fitting snugly into the aperture. Dubbed a "wafer" door because it is not substantial enough to impede long an intruder, being soft and pliable and not heavy enough to close of its own weight, this type of door seems not to be defensible by strength alone. As an innovation *Myrmekiaphila,* the spider that spins this type of door, has within the main burrow a secret side chamber, likewise closed with a trap door, into which it retreats and which it defends by holding it fast against the silken wall of the main tube. It is quite possible that this sort of strategy is sufficient in some cases to confound the predator.

Still another type of defense is presented by *Cyclocosmia,* a curious trap-door spider whose abdomen is round and leathery, forming a flattened disk behind. When disturbed, *Cyclocosmia* retreats head downward to the innermost recess of the tube to a point where the hard disk of the abdomen fits it perfectly, plugging it like a stopper. The coriaceous abdomen is so tough that no predator is able to get to the vulnerable part of the spider while it maintains this position.

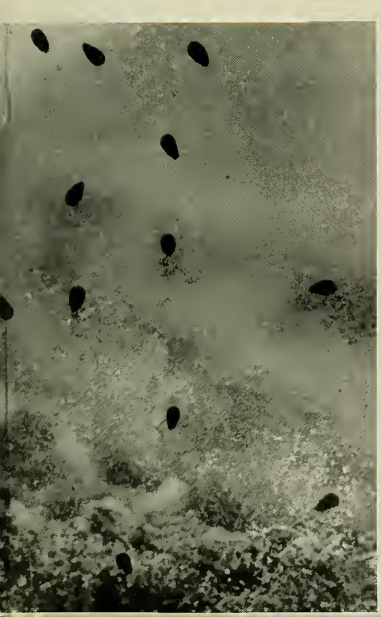
Thus, the trap-door spiders, pioneers in the art of hiding their burrows and capping them with a tough, movable door, have contrived to protect their homes by some of the most extraordinary devices to be found anywhere in the animal kingdom.

The Spider's "UNINVITED" Fly Brings Doom

The private life of an insect who lives a year in the dark for just five or six days of sunshine and love

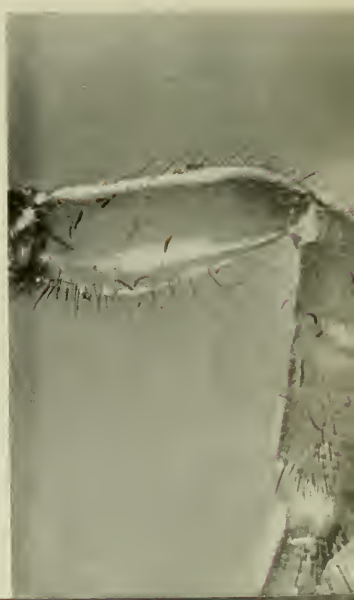
By George Elwood Jenks

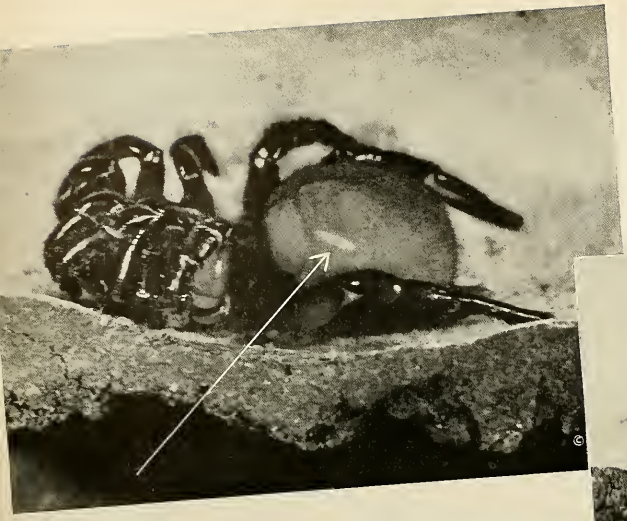
The foregoing article tells how the wily trap-door spider fortifies itself in a castle which is all dungeon and whose "portcullis" is a marvelously arranged hinged door. But as shown in the following pictorial story, even so well ordered a life as the trap-door spider's is not free from mortal danger. An enemy against which the spider has no defense is the unobtrusive fly, *Ocnaea smithi* Cole, who, like all good revolutionists, bores from within.



1 The insect we shall follow comes from one of hundreds of eggs laid by the mother fly, who in flight sprays them over the land of the trap-door spiders *(left)*. The complex mission which awaits the offspring is not evident from the tiny, nondescript egg from which it originates. Yet each one will go through its multiple changes and fulfill its intricate destiny with as beautiful precision as if each original cell contained the written rules and orders for a whole cosmic universe

2 When the egg hatches, the microscopic larva finds its way into the nest of the spider, penetrates the skin, and makes itself at home within the body of its "host." In this laboratory experiment there were so many larvae that they bored into the legs *(as shown at right)* as well as the abdomen. More than one parasite rarely enters each spider's abdomen under natural conditions





3 At first it grows very slowly and changes into a white maggot, clearly visible *(at left)* through the spider's transparent skin, to which it is attached as it feeds upon the fatty tissues

4 *(Right)* With the coming of another summer, the maggot begins to grow more rapidly. Already *Ocnaea smithi* occupies a conspicuous patch beneath the spider's skin, giving us an unusual chance to study a youthful larval form. This form will change completely, as shown opposite, when—

6 The spider has been no match for this subtle intruder and lies dead in his underground "castle." When the cupboard is bare, the invader works her way up the wall, flowing like a snail

7 Pecking at the silk lining of the underground nest, she apparently mixes the silk threads with "saliva" to form gooey strings and guy ropes to hold her in position as she continues her body changes

5 —the larva, which is to become a female fly, bites a hole in the spider's skin and backs out, her body flowing constantly from one shape to another. But her head will remain within the spider for another day or two, until she has "cleaned" her host

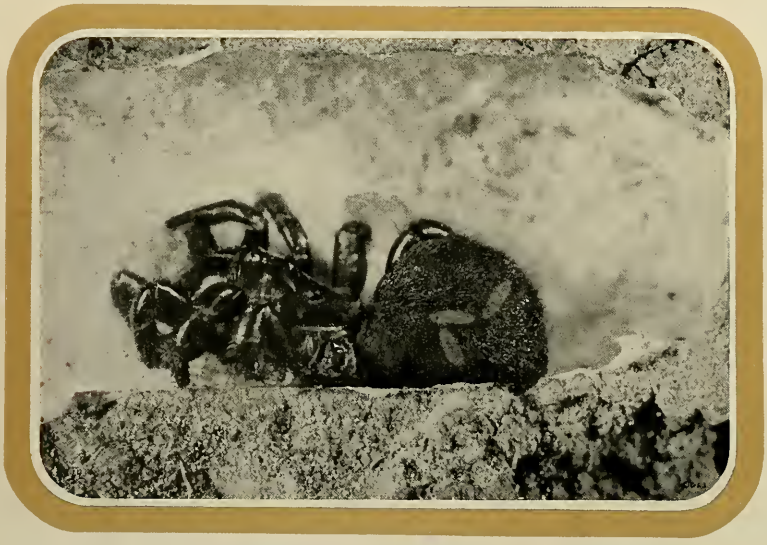
8 Slowly *Ocnaea* becomes still, the liquids of her body seeming to jell in this form. Her "neck" begins to swell and she slowly dissolves into her next definite form

9 We might call this form the "chicken head" pose. (Technically speaking this is a prepupal larval stage.) She holds this pose for several days and then makes a "quick dissolve" into the first pupal form *(over)*

10 Her "torso" seems to have developed at the expense of her tummy; and she sheds another transparent veil. *Ocnaea* seems to be developing a sad case of swelled head, but as we watch we see that—

11 —she is only a pinhead after all. What appeared to be a bulging cranium is only the hump of her shoulders. The only head she has is the small black "snout," and this is mostly eyes!

"TWINS"



14 In the rare cases where several larvae happen to find and grab the same meal ticket, as shown at left, we have what we might call "synthetic" sets of twins, triplets, and even quadruplets. It is rather startling and bewildering to see a whole troupe of larvae doing plastic poses at the same time; let us observe a pair of twins

15 When parasitic "twins" grow up together in the same "apartment," complications are sure to arise. Since the food supply is limited to one spider, each twin can be only about one-half the normal size, unless he eats faster than the other fellow. If it is a small spider, the larvae will be smaller, too. But, fortunately, whenever the meal ticket runs out, the larvae of many insects can straightway pupate and mature, and so we find both monsters and midgets in the *Ocnaea* family

12 Ocnaea wriggles herself out of her last veil, which is clearly visible now that she leaves it empty. But what is this? Is *Ocnaea smithi* taking more recognizable form? Digging her toenails into the silk lining—

13 —she pulls herself free to take her final pose, in which Mother Nature clothes her properly for stepping out into society. About two days will complete her yellow-and-black ensemble, shown in the first photograph

16 But what is this? Scarcely an even start. While *Ocnaea* enjoys her beauty sleep, her childhood neighbor emerges—and proves to be a handsome young man!

17 And so a happy surprise awaits *Ocnaea* as she sheds her last veil, and crawls up to join her neighbor. She will not even have to "step out" to find her mate

18 Perhaps the little bride would prefer to be married in this misty white "coming out" dress, but Mother Nature decrees the uniform yellow-and-black. And while the "new-clothes-while-you-wait" are taking form upon them *Ocnaea smithi* is approaching her nuptial ceremony. But—

19 —they cannot live long on love alone. Like many another adult insect, they have no functional mouth parts and cannot eat! A whole year in the dark underground—in a spider's insides—just for five or six days of sunshine and love!

NIGHT ANIMALS UNDER

By GAYLE PICKWELL

THE employees of Sequoia National Park have their permanent quarters at Ash Mountain in the open blue oak woodlands of the great Kaweah gorge only 1200 feet in elevation and near San Joaquin Valley. During the park season most of the men work in Giant Forest among the Sequoia Big Trees, where the Sierras reach to 6500 feet. Under the Big Trees these men are accustomed to daytime friendliness of mule deers, black bears, tree squirrels, ground squirrels, and chipmunks; and they return in the evening to Ash Mountain to a nighttime world with animals even more unusual than those of the day. Tree squirrels, ground squirrels, and chipmunks are diurnal, but at night at Ash Mountain their places are taken by a truly fascinating group of nocturnal animals. These animals come to eat the food the park employees have put out for them. There are gray foxes, raccoons, striped skunks, and that unusual tree-climbing mammal, the ring-tailed cat.

Animals normally so timid, so wary, so unapproachable, here come near. Many will take food directly from human hands. Mr. Edwin Booth, Park Forester, has the answer. "Here," he says, "there are no guns, no house cats, no dogs. These are our pets." To Jack Crone, Timekeeper, the animals are not only friends but intimates. He spends a large part of his income on food for them. They enter his cabin, which always has the door invitingly open, and he boasts of skunks which sleep on his bed. It was near Jack Crone's cabin that the best opportunity for study and photography was presented during the fall of 1939; and here during October and November dozens of pictures were taken in nighttime photography as thrilling as any a naturalist has ever experienced.

(Above) AS SOON as the evening shadows of neighboring peaks fell over Ash Mountain the gray foxes became active. They were observed running here and there beneath the oaks while there was still sufficient light to see them clearly. They moved with smooth and noiseless spurts interspersed with stops as they approached the sugared bread, which all these carnivorous animals ate freely and which all but the striped skunk preferred. The foxes were enticed to the cameras by tossing bits of the bread toward them. The tossing coaxed them nearer and nearer until these sleek, wary, beautiful animals were within four or five feet of the cameras

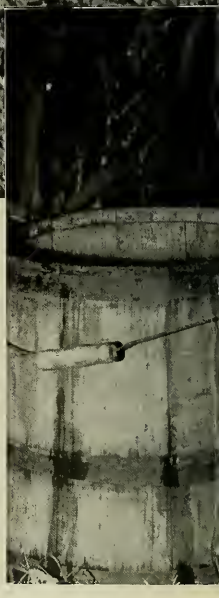
THE FLASHLIGHT

PHOTOGRAPHS BY THE AUTHOR

(Below) AN HOUR or more would pass, and darkness would be well established before the raccoons came. Their approach was unmistakable for they came in groups, noisily, relentlessly, like an avalanche. They descended upon the bread fragments, gave coughing snarls at each other, and reached for the food with forefeet stretched forward together like clutching hands. They came in family groups, with two mothers and young, making as many as nine. Seven were captured in this one picture

THE FOXES retreated before these relentless animals and sat on their haunches at one side or watched intently for the raccoons to leave, as shown above

THE RACCOONS were also clowns and acrobats. They seized stew from a stew pan and crouched back as they lifted it to their faces with their forefeet



(Right) THEY FISHED food dexterously from a pail of water and stuffed it into their mouths without dropping from the rim of the bucket. With their forefeet extended they snatched food fragments from human hands

They would rise with forefeet extended as if to catch, as bread fragments were tossed toward them, and some stood upright on the hind legs and walked forward with forefeet extended like imploring mendicants

There were three or four foxes, as many as nine raccoons, but on the October and November excursions to Ash Mountain never more than two skunks were seen. The skunks came singly, often while the raccoons were still before the camera. The skunk rushed at the raccoons, its arched tail lifted high into the air and the forefeet patting the ground with the resounding whacks which are the skunk's warning of attack. The raccoons ignored the skunk, though the foxes gave ground before it. In spite of this activity and the tail warning no casualty could be sensed with the nose. The skunk would persist in the vicinity in spite of undisturbed raccoons and went over the ground slowly and methodically with a rapid sniff, sniff, sniff, as it searched for food. Only the nose seemed to be utilized, though eyes were most significant with all of the other animals. The skunk at one time seized a large piece of bread and carried it away to a retreat beneath a cabin; again an apple core caused it to do the same; and at times without apparent reason, it deserted food and lumbered away not to return for some hours.

On one occasion the skunk ran across some potato chips which had been unintentionally dropped and would not leave them to come before the camera. Because of this, potato chips were later used as the attraction before the camera. But again the skunk found the first chips by the photographer's chair, persisted there, put forefeet on the photographer's knee in its quest for more, took chips from fingers, sidled up to Marjorie Poff, a student who was sitting on the ground nearby, and climbed briefly into her lap. Great control was necessary on the part of everyone, the greatest on the part of Miss Poff

(Above) On the author's first visit to Ash Mountain, Joe Elliott, forest Guard, climbed an oak near Jack Crone's cabin, caught a trusting ring-tailed cat and released it in a cabin. Here it climbed the wall and stretched out along the window shade roller for those present to admire its large, luminous, nocturnal eyes and tail of fabulous length. It allowed itself to be stroked and shortly accepted food offered by hand. When released, it climbed a tree, went over the cabin's roof, and again came down the tree trunk to take food from offering hands *(right)*

On a second visit, a ring-tailed cat came over a cabin and into a blue oak to descend to seize sugared bread when offered it. On a third occasion the cat was not in evidence until 3 a. m., and on the fourth and last it was not seen at all. On this last trip the skunks too, were not seen. It is sincerely hoped that cat and skunk had not been added to the scores of scalps a state trapper was collecting just below Ash Mountain outside the park in the name of ranchers who demanded protection for their turkey flocks in nearby San Joaquin valley

I KNEW A FOX—*The story of Rusty, a "phantom" two-toed fox, wily invader of henhouses, cunning hunter, and fearless spirit of the wild*

By Roy L. Abbott
Professor of Biology, Iowa State Teachers College

This is the story of Rusty, a red fox. I knew him first when he was free, became really acquainted with him while he was a prisoner, met him again after he had escaped, and had the misfortune to be near him at his death. From the very nature of things, our relationships which spread over a period of three years were necessarily somewhat disjointed, but I shall piece them together, and here is the beginning:

For a long time I called Rusty, my "phantom" fox. I saw his tracks in the thick, yellow dust of the country road morning after morning as I tramped along it through the white oak woods which spread over the clay bluffs of the Iowa River, to my little rural school. He seemed to take delight in seeing how many times he could cross that particular road in one night's time. Foxes were plentiful in that vicinity, my pupils told me, but regardless of this, I knew the tracks I was watching were all made by the same fox—there could be no two foxes in that neighborhood each lacking the same two toes from the same foot as this fellow was. In fact, it was this peculiarity of his track that first caught my attention—the clay dust, especially when a little damp, showing the impression of his mutilated foot almost as sharply as would a plaster cast.

I saw so many of his tracks—always in that perfectly straight line that foxes make—and on so many different days without seeing him, that our hide-and-go-seek game, as I called it, became sort of uncanny. I often found myself tense, as I catfooted it along the road, always hoping to surprise him just around the next corner, and I had the definite feeling of being watched—that the sly rascal was lying somewhere there behind the hazel brush which lined the road and grinning gleefully as I passed. In my vexation, I often tried to imagine how it would be to have the eyes and nose and ears of a fox, to be able to live entirely by one's wits as this fellow lived. But even a "phantom" fox can seemingly become careless, and this one did.

On this particular morning I didn't follow the road, but was making a short cut through the trees, when there, not more than a hundred feet ahead, I saw a marvelous dog fox gamboling like a kitten in the leaves. I could scarcely believe what my eyes told me. Where were those wonderful eyes of his, that keen nose, those ears attuned to the faintest squeak of a mouse? Pshaw! Foxes couldn't be nearly as smart as I had supposed, and for a moment I had a feeling of keen disappointment; if this was really my phantom fox, he had surely let me down.

Then reason hastened to excuse him. For one thing, it had rained the night before and my feet trod soundlessly among the leaves. Also a light wind was blowing across him to me, and the early morning sun was at my back and shining straight into his eyes. Respect for him returned as I thought of these things: old Mother Nature had simply stacked the cards of circumstance in my favor and I'd be a fool not to take advantage of them. So stepping behind a tree, I got out my field glasses, peeped out cautiously and looked him over.

Like a king

It is rare that anyone sees a wild animal at its best. As a hunter, I have shot many wild things, but in spite of my elation over their capture, the dead creatures I have picked up were not really those at which I had aimed. Foxes in zoos, also, in common with many other animals, are but furtive, slinking creatures, and those I have caught in traps were but snarling, vicious brutes transmuted by pain and fear into mere caricatures of real foxes.

But this one now before me—how like a king he was! Free, unfearing, the very spirit of the wild!

This was the first fox ever to show himself so close to me in the wild state, and I believe I have never seen a more beautiful or more graceful creature. His long hair, red and gold, gleamed in the sun, his slim legs booted with black for half their length, bent and flipped like steel springs, his muscles rippled under his sleek hide, his alert face fairly shone with intelligence.

What was he doing? I have said he was bouncing about like a kitten, but there was obvious purpose in his actions. With a quick flip of a slender paw, he would turn a pile of leaves, and then his jaws would

snap quickly right and left at something that came out from beneath. It was something agile, probably crickets, for they were plentiful in the leaves, and foxes, although great mousers, never refuse insects when there is nothing better. Once in the very midst of his frisking, he suddenly sprang high into the air, his jaws snapping sharply, and half-reversed himself as he fell. I couldn't see the cause of this, but in it, I saw a possible meaning of a trick I once saw my dog perform.

We were quail hunting, and my pointer had just jumped a log. As he landed, a rabbit bounced high into the air, and with one lunging snap, my dog killed the rabbit in mid-air, dropped it instantly, and went right on about his quail hunting. He had acted purely reflexly no doubt, for he had been taught never to hunt rabbits. But to return to the fox.

Darwin remarks in one of his books that the ability of any animal, even an earthworm, to fix and hold attention upon what it is doing, no matter how trivial, is a positive sign of intelligence. If so, the fox before me must have been very intelligent, for the crickets or whatever he was catching, held his attention as if there were no other creatures for the moment in all his world. So intent, indeed, was he upon his breakfast, that he never noticed that I—treading carefully and keeping tree trunks between us—had come within a dozen yards of him. It was unbelievable, but there was that shining, frisking red fellow as proof.

Foxing a fox

I wanted to spoof him a little, so during one of his gyrations, I gave a sharp, short whistle. Its effect was instantaneous. Like a dog that has come suddenly upon a hidden bird, the red rascal froze instantly, one front paw lifted, his black tipped ears thrust forward, his muzzle half-hidden in the leaves. He held this position for a moment, then slowly his head came up, as he looked carefully around, sniffing and sampling the air from all sides. But apparently detecting nothing, he soon turned back to his cricket hunting. I waited a moment, then again whistled.

This time he apparently thought the matter needed investigation. Slowly he backed against a tree as if determined not to be taken from the rear, sat dog-like on his haunches, and looked about for a full minute, his roving eyes seemingly taking in every detail. Yet I took care that only my nose and glasses were showing alongside of a tree trunk and, as I said before, both the breeze and the sun were in my favor. But after a time, he apparently decided that he had been mistaken and again returned, though it appeared only half-heartedly, to his hunting. Then suddenly realizing that I must be on my way to class, I reluctantly stepped out into full view.

At sight of me, he half-squatted, stared at this tree suddenly transformed into a man. Then away he flashed, his white tipped tail streaming out behind like a flag in a breeze, across a narrow creek in a leap and down a gully out of sight.

I walked over to where his flying feet had landed on the sandy edge of the stream and there, sure enough, was the mark of a two-toed foot. At last, I had really met my phantom fox—Rusty, or Two-Toes, as I afterwards learned to call him.

It was under very different circumstances that I next met Rusty. In fact, I had practically given up hope of ever seeing him again, for his tracks disappeared from the road, and although I went looking for him many times through that same woods, he never allowed me the slightest glimpse, and I feared he had been killed or had left the neighborhood.

The "phantom" is caught

Then one morning following a light snow, one of my older boys at the school told me that a big fox had raided their henhouse the preceding night and had killed and carried away three chickens. He had followed the tracks and had found one of the hens hidden in the edge of an old straw stack half a mile away.

I thought of Rusty right away, but hesitated to ask the boy if the tracks showed any peculiarities. And I didn't need to, for he finally blurted:

"That old chicken-killer wants to look out. But maybe bein' in a trap before has made him wise to 'em, for accordin' to his tracks I'm clean mistaken if he's not already lost two toes from some deviltry or another."

Of course he could be talking only about Rusty, and I secretly invoked the fates that preside over the destinies of foxes to keep him from the boy's traps, but to no avail. For two mornings later, the boy gleefully announced that he had caught the villain.

"And you know, Teacher," he added, "I believe it's the same fox we had for a while a year ago now. Pa and me dug a den of 'em out, and I kept one till he was half grown, and then he dug under the pen and got away. Maybe bein' used to man smell was why I caught him so easy." Would I stop by that evening on the way home and see him?

Yes, I would, but I hated to do it. However, there was no way out of it, for the boy knew my interest in animals. But to my astonishment, instead of seeing a dead cold thing as I dreaded, I saw a real live fox in a big wire cage. It was Rusty, sure enough—looking pretty crestfallen, it is true, but not badly hurt. The boy wanted to know if Rusty wouldn't make an

excellent breeding fox if he could catch or buy a mate for him.

Naturally I fell right in with this idea, and soon found myself making twice-daily visits to see Rusty on my way to and from school.

At first, Rusty paid but little attention to me, either continuing his constant pacing back and forth in his cage when I stood a rod, say, from it, or merely laying back his ears and snarling if I crowded him too closely. But I had no trouble seeing that the boy was probably right in believing that he had recaptured his pet, for in a few days he had a collar around the fox's neck, and was leading him at the end of a chain. While first breaking him to lead he told me, he kept the fox from rushing in to bite him, by means of a long hickory pole with a snap at the end which he fastened to a ring in the animal's collar.

Affection in fox language

But I believe I finally won my way to Rusty's toleration, if not his regard, by way of his stomach. For Rusty, like all foxes, had a great weakness for mice, and after bringing him a dozen or so live ones, he apparently began to associate me with this delicacy. At my approach he would come rapidly to the side of the cage, showing me by all sorts of twistings and grins and fox language generally, that I was carrying what he wanted in the worst way.

He was amazingly quick at catching a mouse, usually picking it up hastily but gingerly, it appeared to me, with the tip of his long snout, flipping it high into the air and then catching it between wide jaws as it fell.

He would eat grasshoppers, crickets, earthworms, snakes, frogs, sparrows, fish—in fact almost every kind of animal—and even berries and apples occasionally. But mice were by all odds his favorite food. Merely to stand by his cage and squeak like a mouse, or better yet to hide in a nearby building and make mouse-like noises by sucking with the lips against the back of the hand, was sufficient to stir him to great excitement. It was surprising, too, how far away he could hear one of these squeaks, and I have no doubt that many a mouse betrays himself to a fox by careless squeaking. Rusty was not particular about the kinds of mice: house mice, field mice, or the white-footed species were all eaten with equal gusto whether alive or dead. Now and then I substituted a short-tailed shrew for a mouse, and it was amusing to watch Rusty on these occasions. His nose would curl in disgust, I always imagined, for he didn't like shrews at all, although he would eat them occasionally, as he would snakes also when very hungry. When he wasn't hungry, any surplus food he received—and particularly the kinds he didn't like very well—was promptly buried as if he thought it might improve with age. I didn't observe him urinating upon these caches as he is commonly credited with doing and which is doubtless only a device for coming easily upon them again by means of his nose.

After several weeks of mouse-feeding, Rusty finally allowed me to scratch him upon the head, but he always laid his ears down when I did this and I had the unpleasant feeling that he was likely at any moment to sink a dozen or so of his 42 sharp teeth into my flesh. He allowed the boy, however, to pet him freely, though I suspect that this was due to a hold-over in his nervous system from their earlier relationship—something in which I played no part.

I never saw Rusty use that marvelous tail of his as a foil in a fight as Seton describes, but I saw him make use of it many times as a nose and foot warmer, and perhaps as a respirator as well. In fact, in cold weather, he never lay down without bringing nose and bare feet close under that thick brush; he would have been lost without it. Seton believes, indeed, that foxes and wolves couldn't survive a winter without their tails.

Rusty was usually silent in the daytime but at night he often barked very much like a small dog. The boy who kept him told me that Rusty also sometimes screamed appallingly at night—a wild, piercing yell that made a tingling on the back of his neck every time he heard it even though he knew what it was. Samuel Scoville, Jr., agrees with this description of a fox's yell and describes it further as being as "rare and dreadful as the screech of the wounded horse which frightened even Hawkeye and Chingachgook."

Foxes usually mate in February or March and many observers believe the mating is for life. But if Rusty was mated at the time of his capture, his mate apparently gave him up for lost, as she never appeared anywhere around his cage. Yet I suspected that his barkings and screamings which the boy described so well were but expressions of his yearning for his own kind, and I secretly hoped that he'd find a way to freedom. And he did.

Prison-break

In making the cage, the boy had anticipated the fox's digging, and had not only placed the woven wire two feet underground but had turned it inward horizontally three feet all around. Rusty had sampled it in various places only to come upon the wire, but, finally, as if discovering that this impediment didn't run all the way across the floor, he sank an almost vertical tunnel in the center of the cage and dug out sideways under the wire in one night's time. That was in April, and when I left that vicinity the first of

the following June, neither the boy nor myself had seen any signs of Rusty. I had supposed that was the end, but there was to be yet another chapter to our relationship.

Nearly two years after Rusty's prison-break, I went duck hunting one March morning into the Cedar River bottoms, at that time much overflowed by the usual spring floods. It had snowed nearly an inch the preceding night, and fascinated as I am by animal tracks which were plentiful that morning, it was hard to keep my mind on the ducks. I was thinking about foxes, too, for I had been away to college, and almost the first thing I heard when I got back was that there was a fox in the neighborhood—a particularly crafty fellow who raided henhouses right and left but never reappeared at the scene of his crimes. Of course, I couldn't help recalling Rusty, but he lived ten miles away, if he still lived, and I knew that foxes were not much given to migration.

Yet I had hardly hit the edge of the timber that morning before I saw a fox's track—and Rusty's at that! There could be no mistaking that peculiar scalloped track of his. What could he be doing in our neighborhood, a place where I had never seen a fox? Yet I recalled that it was March, that the mating moon was on, and that Rusty had known men better than most foxes. Perhaps with all his experiences I couldn't expect him to behave like an ordinary fox.

His tracks showed him to be hunting—that tireless sequence of small round prints placed one after another so nearly in a straight line that I have often marveled how a fox can make them and still keep on an even keel. Some of them were obviously fresh, too, and I found myself thrilled as I momentarily expected to meet him.

And sure enough I did. As I rounded a thick copse of hazel, he was standing there full face to me sniffing at a rabbit he had apparently just killed and looking as glorious as he did that first morning I saw him in the white oak woods nearly three years before. I think he knew me too, but in spite of my calls he picked up his prize, turned deliberately and was soon out of sight.

I turned finally to my half-forgotten duck hunting and toward noon met an old schoolmate who was also hunting. After a while we sat down together for lunch. I noticed his game pockets were bulging.

"Any luck?" I asked

"Yes," he said, "a few mallards, and something I never saw before around here." He reached into his pocket and dragged out the still fresh skin of a red fox.

"That fellow came up within 50 yards of me," he said, "just as if he wasn't afraid. Must have weighed fifteen pounds. I skinned him out so as not to carry all the weight. Isn't he a dandy?"

And the only thing I could do was to nod, as both eyes and fingers sought and found the scar of those missing two toes.

DO NOT MISS

To secure ancient and ornate scrolls revealing the practically unknown history of a people, **QUENTIN ROOSEVELT** pressed into the interior of war-torn China where the Nashi "devil priests" cling to the remnants of their once great power. Entering monasteries previously visited by few white men, he came away with a treasure trove of beautifully wrought pictographs and lived to write his tale for a forthcoming issue of NATURAL HISTORY Magazine.

The immensity of Nature's handiwork upon the surface of the earth springs to life in John C. Reed's panorama of that glistening land of glaciers—southeastern Alaska. In this sweep of aerial photography the reader may look down as a visitor from another planet to view **HOW TOTEMLAND WAS CARVED.**

The eagle has ruled Man's imagination since the dawn of Time, unfurling five thousand years of history behind his wings. Lucy Embury does full justice to the "King of Bird's" eventful history in her nimble and colorful **ODYSSEY OF UNCLE SAM'S EAGLE.**

Where would you go to find the most beautiful land shell in America? Why would you look in the air for it? And would the newly hatched *Liguus* be a perfect replica of the adult, even possessing a tiny shell? These questions and many others on the life of this creature will be answered shortly in NATURAL HISTORY Magazine, in **TRAILING OUR MOST BEAUTIFUL LAND SHELL.** The shells of these snails are a favorite hobby of many collectors, yet of one species only a few specimens exist throughout the world, and the survival of others is seriously menaced by disregard of conservation.

Animals are said to give primitive man over half of his words. We may forget our fellow creatures in many other ways, but in **SPEAKING OF ANIMALS** James G. Needham will show in a thoroughly amusing way that animals give us the most picturesque expressions in the King's English.

Those whose thoughts are turning toward the vacation land of the West will enjoy a pictorial excursion into the country of the Colorado, in which Josef Muench will show you **A CANYON RIVER** which has three waterfalls higher than Niagara and harbors an entire tribe of Indians within 13 miles of its length.

COURTSHIP

of the

Magnificent Bird of Paradise

Drawings by B. F. Chapman

Does the male bird of paradise, who wears all the fine feathers, attempt to win his mate with the appeal of beauty? A naturalist takes you to the slopes of the Snow Mountains in New Guinea to witness the rare spectacle of his courtship

By A. L. RAND

Research Associate, Department of Ornithology, American Museum of Natural History

I REALIZED one of my ambitions in my New Guinea work last year when I was able to watch the courtship of the magnificent bird of paradise *(Diphyllodes magnificus)*. As I sat in a little palm leaf shelter beside the display ground of one of these birds and watched it at little more than arm's length, I felt that this was for me one of the most important moments of the expedition. As I watched I realized that the colors of the bird could never be recaptured in paintings or be seen in stuffed skins in the same true brilliance as here in this New Guinea clearing. And circumstances prevented me from catching all this with the camera.

The velvet and metallic green of the breast shield was like burnished metal, the yellow-orange of the wings gleamed, and the feathers of the pale yellow-white cape which could be erected above the head were like spun glass. As I looked closer I noticed the loose watchspring curl of the elongated tail feathers, metallic green in color, and occasionally saw the pale greenish-yellow inside of the mouth.

No wonder that the coloration and ornamentation of this bird and its gaudy relatives earned them the name of birds of paradise. Skins of these birds arrived in Europe even before the Portuguese discovered the island of New Guinea in 1526. Native traders had realized their beauty and had brought them to the Indies where the early European spice traders found them and took them back to Europe. These crude native skins reached Europe without wings and feet, and the great biologist Linnaeus of the 18th century called one species, *Paradisae apoda*—the footless one from paradise. Strange tales were invented of their habits: they were said to float about never perching, always turning toward the sun, and to feed on nectar.

It was partly to see these birds in life that brought some of the pioneer naturalists to New Guinea. D'Albertis, the distinguished Italian traveler, sought them; and A. R. Wallace was the first Englishman to see these birds alive and has given us vivid descriptions of the birds' appearances as they occurred

PRESENTLY *the male went into the full glory of his display, with breast upward, velvety shield glistening as though burnished, and yellow cape shot forward under his head*

in the forests, and summarized the knowledge of that time in his classical volume *Malay Archipelago* of 1869. With the additional information about these birds now available, though still woefully incomplete, their real habits seem nearly as marvelous as those earlier alleged.

The communal dance of the greater bird of paradise with its long yellow flank plumes is a thing of amazement and of surpassing beauty; other species with capes, long tails and strange head ornaments indulge in striking poses and antics that display their peculiar feathers to their best advantage. Sometimes these displays are communal, sometimes solitary in places cleared by the bird especially for this purpose.

Why?

Naturalists have wondered what these actions mean: what they have to do with the life of the bird and what factors caused their evolution. Did the males, who in this case wear all the fine feathers, display so that the females could come to choose the most beautiful? Did the males attempt to outdo each other in display to frighten their rivals away, or was the display to charm the females? No wonder I was excited to be able to watch a display and find the answer to some of these questions. My opportunity to do this came when I was camped on the lower slopes of the Snow Mountains of Netherlands New Guinea in the steep wooded country just below the mossy forest. Here pine trees and oaks with large acorns mingled with bamboos, bananas and palms; balsams and orchids added color. The magnificent bird of paradise was common here. Its loud calls carried far through the forest and were heard daily as I hunted there for new birds. Some of these birds of paradise came to feed on the fruit of a tree by my tent.

The first display ground I found was only about 200 yards in a direct line from camp. But in New Guinea one can rarely go in a straight line. It took about fifteen minutes for me to reach it, so steep and rugged was the country. The route led down into a steep ravine and out again, into another and yet another. The ground was slippery and our Dyak porters had tied rattan, which dangled alongside the path, to trees, to be used in pulling oneself up. The display ground, about 20 feet across, was just under the crest of the third ridge.

As in many places the ridge here was so steep that the rapidly eroding, slipping soil had not allowed the forest to establish itself. There was a considerable

area of ferns and saplings. Here the birds of paradise had made their playground on the steep slope just below the ridge crest. It had been in use for a long time. The saplings had been killed, many had their trunks frayed from the bills and feet of the birds, the ferns were gone, and the ground was mostly covered with a thin layer of moss. Only a few larger sticks interrupted its smoothness. Leaves, twigs and ferns had been cleared away and lay in windrows like raked brush at the lower edge of the bower. It was a hole in the jungle, where daylight unimpeded reached the ground. The bird had improved this area so that the light would show his metallic colors to better advantage.

The male was too shy to be watched without a blind, so I made one just at the upper edge of the display ground on the top of the ridge. The blind presented no difficulties. My Dyak gun boy cut a leaf of a fan palm, about ten feet across. This he fixed in the ground by its own stem. The segments of the leaf I pinned together with twigs, and I had a dome-shaped hut. I added a few leaves to fill in the bottom, cut windows, made a door, and the blind was ready. I added another leaf on the top, and had a rain-proof roof. I watched from this hut.

When I saw the male at work on the display area I soon realized how this area had been made. Most of the time the male spent on the ground. Leaves and

"... THE MALE *then went into another type of display. The tail was erected at right angles to the back to display its glittering underside, and it pecked vigorously at the nape of the female"*

twigs which had fallen in the clearing over night were thrown out with a quick flirt of the head; if they did not reach the edge of the clearing by the first throw, the bird sometimes followed and threw them several times until they joined the windrow at the bottom. Occasionally the male went up into the saplings above the display area, prized off bark, broke off dead twigs and pulled down live leaves. He then followed them into the court and threw them out.

When I found that a single adult male spent much of his time alone at the display area, I tried to gain an insight into his behavior by introducing mounted birds into his court and watching his reactions. Some birds of paradise will display for mounted birds as has been found in zoological gardens, but I had poor success with my decoys. The male was shy of the mounted female which I introduced one day; he kept low around the edge of the bower watching her as though suspicious. I had slightly better luck with a mounted adult male. No sooner did the adult male return to his bower after I had disappeared into the blind than he dashed in, perched on the mounted male, erected his crest and pecked its head as though to drive it away. But after this he, too, seemed suspicious, and sat about half an hour on a perch about ten feet away watching it. As the mounted bird made no movement, neither did the male, and finally I gave up in disgust. From this it seemed that the adult male actually tries to drive away intruding males by combat as well as using its plumes to intimidate the intruder.

Display

But the display was the most spectacular activity. Several times I saw the male display alone after a period spent in cleaning the court. But finally a female came. It was at 2:40 p.m. on March 28. The male was on the ground clearing away leaves when I heard another bird flying to a perch close to the blind. The male was all attention at once and flew up onto a perpendicular sapling a little above the ground. The female, as it proved to be, then came into the display ground and lighted on the same sapling about three feet above the male. The male pulsed his breast shield in such a way that it was more or less expanded and the upper, outer corner of the shield raised so that in extreme cases these corners stood up as points on each side of the head. Undulations in the breast shield sent shimmers of iridescence across it. The iridescent spots in front of the eyes became conspicuous. He continued this pulsing of his breast, keeping the breast turned toward the female as she moved from sapling to sapling, keeping about four feet above the ground.

Much of this time the male was calling low, enticing, questioning calls of "eeek" or "eee." The female sat still and quiet while perched.

Then the female flew to another perch about eight feet away on the edge of the display ground as though she were going to leave. The male at once turned his back on her and made as if to hop down to the ground to continue his cleaning. The female immediately came back to directly above him and he at once forgot his interrupted duties and turned toward her again, pulsing his breast shield. Again the female flew away to another perch, and the whole ceremony was repeated: the male started to go back to work and the female at once came back. After this, while the male was giving his breast pulsing toward her, the female began to hop down the sapling toward him. He pressed his breast close to the sapling, pulsing the shield, and gave low, eager, single little calls. The female paused about one foot above the male, who was about the same distance above the ground.

His full glory

The male then went into the full glory of his horizontal display: suddenly he extended his body horizontally from the sapling, breast upward, the velvety breast shield glistening as though burnished, the yellow cape shot forward under his head, the tail was in line with the body and vibrated rapidly, possibly from the tenseness of the muscular effort required for the position. Otherwise the bird was motionless. He held this position for perhaps 30 seconds. The female hopped down closer to admire the display, and the male abandoned his position and rather deliberately hopped up and mated with her. The male then hopped down to the perch just before her, and went into another type of display. The tail was erected at right angles to the back to display its glittering upper side. It pecked vigorously at the nape of the female, and after each peck it drew back with widely opened mouth displaying the beautiful yellowish-green lining so plainly that I could see it from the blind. The female was unmoved and in a few moments she flew directly away from the display ground, while the male remained there flying in and out of it excitedly for a time and then went to one of his favorite perches calling loudly.

This gives an answer to some of the questions about birds of paradise; in this species the display ground is the property of one male who is in constant attendance and advertises his presence by loud calls which attract the female. But before mating, the female must be aroused to a suitable emotional state, which is done by the display of the male before the actual mating. The pecking display is a post-mating display.

COMMEMORATING FIVE HUNDRED YEARS OF PRINTING

AMONG those who regard the history of our civilization as the history of its great books, the year 1940 takes on a special significance, since it marks the commencement of Printing's second 500 years

In this connection it seems fitting to re-examine one of the earliest books ever to be set in type—Pliny's *Natural History*. Existing in manuscript form many centuries before the time of Gutenberg and Caxton, the book remains to this day the greatest single repository of science of the Ancient World.

Within its pages we may find many a tall tale. Yet there also are the germs of scientific truths still being verified after 2000 years of the Christian era. Pliny anticipated some of the more arresting aspects of Darwinian evolution in the inference, to quote one of his commentators, "that the first creatures were produced in moisture and were covered with a spiny integument—a suggestion that has a curious and relevant application to the armour-plated coverings of prehistoric fishes. In the course of time, he added, they reached dry land as animals—again anticipating a sound evolutionary process. He even went so far as to hazard the suspicion that man himself originally resembled a fish."[1] His observations on inherited characteristics in Man show not only a keen appreciation of the cultural and environmental factors involved but clear traces of the Mendelian theory on which the modern study of genetics is largely based.

The idea that a ship would reach India by sailing west from Spain was familiar to Pliny *14 centuries before Columbus*. His eulogies on insects rival those of Fabre, and considering his lack of microscope he knew a great deal about them.

Not the least interesting sections of his writings are those revealing the antiquity of several of our best known sayings. "Keeping a cool head," for example, stems directly from the Aristotelian notion that the brain was the coolest and moistest organ of the body. Hence a cool head guaranteed a properly functioning brain. That a thick skin resisted "the entrance of subtle air and fine spirit into the body" shows how deep-rooted is our habit of calling insensitive people "thick-skinned." And that a person's ears "tingle" when someone talks about him behind his back, was a byword in first century Rome.

It is no wonder, then, that Pliny's *Natural History* was chosen by Europe's earliest printers as the first book in this field to be set in type. It has been called "the most popular natural history ever published."[2] Today, as with many other ancient works, it is very rare, only two copies of the first edition existing in America.

This year, the 500th anniversary of the printing, prompts us to look back upon the knowledge of the ages, and it is with this thought that the Book Shop of the American Museum of Natural History has arranged an exhibit which many will want to see, embracing a fascinating array of antique volumes and mementoes.

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[1] H. N. Wethered, *The Mind of the Ancient World* (London: Longmans Green & Co., 1937).
[2] E. W. Gudger, "Pliny's *Historia naturalis*," *Isis* (No. 18), VI (3) (1924).

The decorative initial above is from C. PLINII SECUNDI HISTORIAE MUNDI LIBRI (*Basil, 1549*)

Seeing Nature *through* THE CAMERA'S EYE

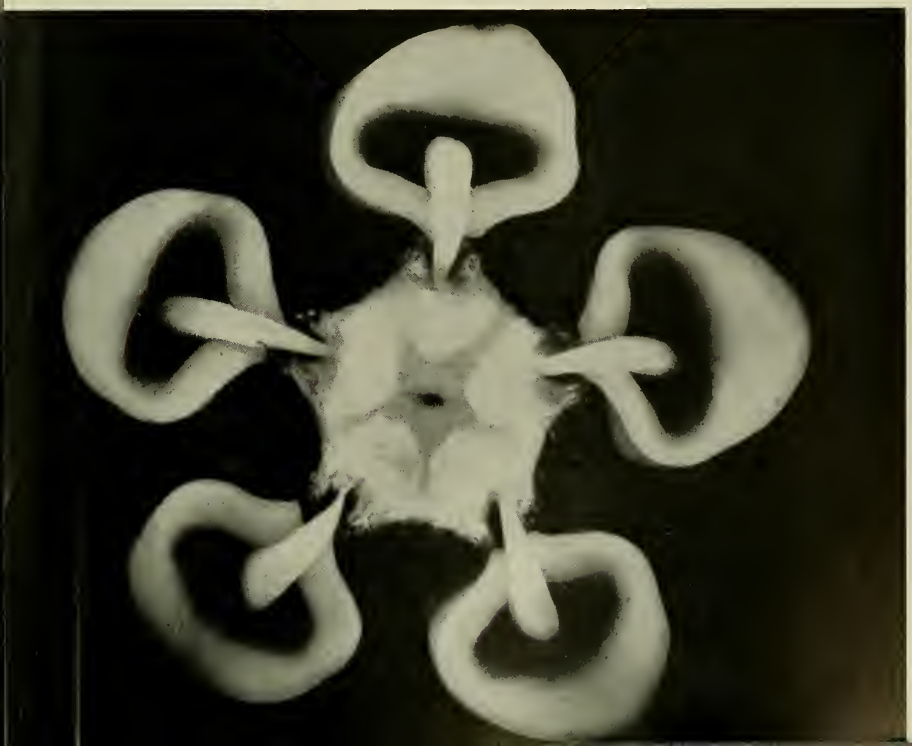
By Rutherford B. Platt

PUSSY WILLOW

LONG LEAF PINE

SHELF FUNGUS

MILKWEED Looking head on at the design of the Flower



REARING A FAMILY

By Ted Trueblood

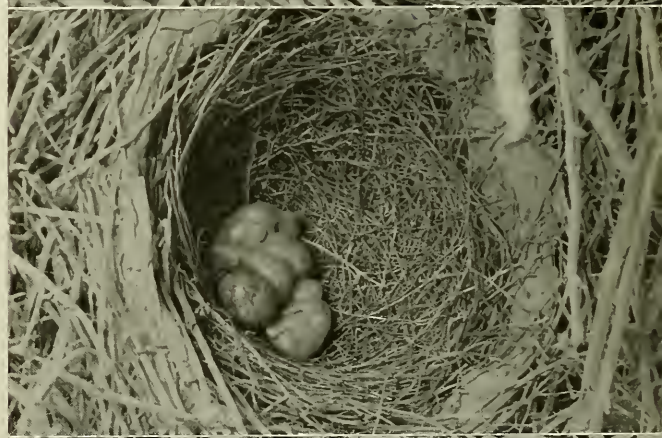
By profession a thief and by instinct a "family man," the magpie is one of the most intelligent of our native birds

Though popular as a talkative household brigand in England's countryside, the magpie is not nearly so celebrated in America as his cousins the jays and crows. This seems chiefly attributable to force of numbers. Crows are prolific from coast to coast, and hardly a nontropical backyard does not know the raucous cry of the jay. Cousin magpie, meanwhile, is restricted largely to the American Midwest and Northwest, where his plundering forays are well known to man and dreaded by birds. Like some of his relatives he is a fool for all that glitters. His nests and other hiding places frequently contain booty ranging from tin spoons to coin of the realm, and there are even tales of his having pilfered diamond rings. More widespread are his depredations on the nests of game birds. He steals and devours their eggs, considerably to the detriment of population. This is a habit of the corvine (crowlike) birds generally and is accompanied by sharp vigilance in the guarding of their own nests. Robber that he is, the magpie is anything but antisocial with his own kind. He travels in flocks and is a highly responsible parent

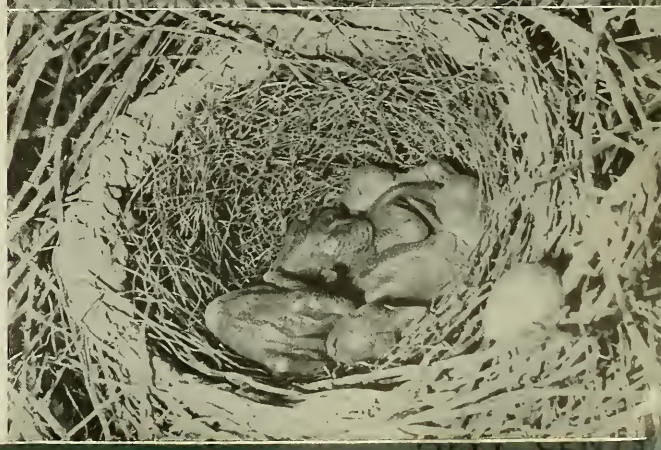
OF THIEVES

(Right) Robber Baron's castle. Lodged in a greasewood bush and composed of an impenetrable mass of thorny sticks, this magpie nest rivals the fortified lair of medieval legend. The comparative size of the nest is shown by the felt hat perched upon it.

(Right) Though proof against enemy maurauders, the fortress yields its secret to the camera eye—five eggs already in the process of incubation. Five to eight is the usual magpie clutch, but sometimes the thorn-girdled home shelters as many as ten



(Right) Life begins with a brood of four, one egg having proved sterile. Only one or two days old, these babes—voiceless, motionless, blind and extremely ugly—give little promise of growing into broad-winged highwaymen like their father *(see opposite page)*. The structurally marvelous nest is a typical magpie construction. Many of their most peculiar traits seem home-centered and directed toward the successful rearing of markedly helpless young



(Right) One week later pinfeathers begin to emerge and the robber baronets are growing rapidly, although they remain voiceless and huddled. Apparently one of the parent birds has crowded the sterile egg to one side of the nest

(Left) FULLY FEATHERED and squawking vigorously, these babes at three weeks are still incapable of flight. Their vociferous greeting of the photographer greatly excited the parents and marshaled a sort of "volunteer fire department" of fellow magpies who came from far and near to "save" the beleaguered young

(Above) HUNGRY AND NOISY, two month-old magpies deserted the nest and were able to fly short distances despite half-grown tail feathers

(Right) STILL GUARDING her two remaining offspring, Mother Magpie menaces the photographer from her fence post outlook. The parent birds became so agitated on the cameraman's approach that they fluttered to the ground, breaking pencil-sized sticks in their bills. In high dudgeon they also pecked the fence post and seized beakfuls of earth

(Above) When do we eat? Primarily scavengers, magpies feed their young by regurgitation, but these month-old huskies are about ready to fend for themselves. Captured at this age magpies may be domesticated and taught to talk. The latter phenomenon has probably given rise to our expression "chattering like a magpie"

(Left) The slow-winged, bobbing flight of an indignant parent bird as it flees from the camera. So important is the rearing of young thieves that magpies seldom remain widows or widowers for more than a day or two. A large gathering of eligible birds is said to form near the scene of death, from which a new mate is promptly selected. This custom is shared with some jays and may partially explain the productiveness of corvine species

THE STORY OF HERALDRY

Heroic symbols have everywhere marked Man's more adventurous activities since the dawn of time, and though coats of arms declined with Knighthood, the modern airplane may possibly bring about a new Heraldry to symbolize achievement in a new age

OF ALL the symbols which confront us in the daily press, none are so potent and certainly few so ancient as 卐 † and $. Should peace come in 1940, it will likely result from an understanding among the head men of immense organizations operating under these three simple art designs whose origin traces close to, if not beyond, the threshold of history.

Nazis did not invent the swastika, nor Christians the cross, nor Americans the dollar sign.* And each emblem has in its time served masters and purposes which contrast strangely with their modern import. Yet they remain mighty cabalistic signs, still rousing our deepest emotions, still working old magic in a new setting.

Today Europe's allied battalions are marching against this reorientated swastika under Gallic rooster and British lion, animal fetishes which were no doubt in prominence on the field of Crécy where knightly warfare met its death blow 600 years ago. The lion, one of the most widespread subjects of animistic primitive belief, has nearly always connoted bravery, and the cock, said one writer of the time, "croweth when he is victor and giveth testimony of his conquest; if he be vanquished, he shunneth the light and society of men"—reason enough for accepting the barnyard ruler as emblematic of a chivalric national ideal. Man has always had emblems derived from the world of animals and probably always will, since he has so far given no indication of being able to get along without them. Moreover, there is scarcely an important culture in all history that does not evince animistic tokens of valor and leadership. They were borne by Persian kings and in the armies of Alexander and Caesar. The present Mexican eagle dates back to the halls of Montezuma, and the Aztec chiefs sported individual shields and banners

*This device seems to have been taken from the famous ribbon-entwined "Pillars of Hercules" depicted on the Spanish dollar widely used in the early days of colonial America. The Pillars themselves are the rocks flanking the Straights of Gibraltar, according to legend, placed there by Hercules.

when Cortez rode inland from the Coast.

Of course symbols of one sort or another are as old as human intelligence, and their remarkable distribution and endurance is largely due to their twofold utility as tools and charms. For example, a symbol may be as simple a designation as a common word in a language, or it may serve to embody a supernatural principle. Both these uses figure prominently in the story of that mythology, art, and science called Heraldry.

One of plastic art's chief functions is to stay the obliterating hand of time. And nowhere does it fulfill this task to better effect than in our Anglo-American insignia of ancestor worship—our true household gods—the family coat of arms.* Perhaps these stylized gatherings of "langued" and "rampant" creatures do not always speak with genealogical accuracy, but they comprise what may well be the truly native religious art of British civilization.

While the art of making heraldic devices and the custom of bearing them probably entered England at a much earlier date, organized heraldry did not reach its apex until the time of Henry III. During his reign in mid-thirteenth century, the art gained its ultimate validity, serving, as it did, a preëminently useful purpose in the British social structure of that day. Considerable impetus was lent to the expansion of heraldry by the Wars of the Roses. For, after this civil strife had spent itself, an upstart nobility arose to replace the ranks of those slaughtered in battle. In order to settle the riotous confusion of real estate claims, these *novi homines* swamped the College of Heralds with orders for coats of arms which would trace their

*A term derived from the ornamented cloth surcoat which knights wore over their armor.

ancestry, however spuriously, to as impressively early a date as possible.

This marked the blooming of the noble-ancestry scramble and the end of heraldry as a natural art, since these doughty knights were fully as anxious to place an apocryphal ancestor on a fat estate as is the modern genealogy hound to run his namesake into the *Mayflower's* passenger list.

Of course, there are many authentic coats of arms, for during its Golden Age the College of Heralds had not yet become corrupt, and the creation of synthetic precedents was, therefore, considerably more difficult to achieve. But later, in Elizabeth's time, the badges and banners of medieval warfare had been outlawed and the style of heraldry degenerated into baroque pomposity, its coinage debased by many a counterfeit and semi-counterfeit escutcheon. Heraldry entered its decadent phase in seeming vindication of the theory that all arts decline when they are no longer a functional part of their social milieu. Feudalism had broken down. The people of England were no longer rigidly segregated on the lands of the chief families, whose armoral bearings served as a model for all their retainers. Formerly, when a noble's vassals were arrayed in the field, they could often be identified by "key symbols" in their insignia. Thus coats of arms were the glorified license plates of their day, designating not merely a man's native county, but his family origins, his obligations, and his station in life.

However, in Tudor England the age of jousts and tournaments was dead. Surviving ceremony apart, no more heralds* emerged from pavilions to announce a passage at arms. Full suits of armor had been replaced by hose and doublet, and the English nobility had taken up the arts of reading and writing. No longer was a man's coat of arms his only mark of identification. He could now affix his signature to some grant or charter where formerly he imposed a seal derived from his armorial bearings—a custom still followed in the royal signet ring. So it is perhaps not too much to say that the heraldic devices, rooted in an older animism, were the quasi-official "language" of the British people during the earlier middle ages. It was then that family history and achievements, and most particularly claims of inheritance, were recorded in blazonry.

British totem poles

In fact, the British family coat of arms is similar in many respects to the enormous totem poles of the Northwest Indians. Just as these animal carvings recorded the clan system and indicated the lineage of individual Indians, so the more varied animal kingdom of the medieval blazoner depicted the feudal clans as well as reliable "legal" data. Consequently, there is a touch of irony in the patronizing curiosity for the Indian later shown by Englishmen themselves only a few generations removed from an age of virtual totemism.

When the era of exploration set in, heraldry had generally reached the status which it now occupies. It was and is the chief symbol of noble birth, and was and is valuable to scholars in dating historical phenomena through an exhaustive study of the various motifs. In short, it is to the British antiquary what Peruvian pottery is to the South American archaeologist—the durable record of a culture.

The ancestry scramble

A number of the stylized animal figures of the armorial devices were probably developed from the totem animals of shaggy-bearded tribesmen who were pursuing the wild horse through the dark forests of primitive Europe long before Rome expanded into a world power.

It has been said that nearly every people must pass through an essentially totemic stage before they attain civilized culture. Europeans are no exception, although their totems were doomed with the establishment of the early monasteries. These repositories of Greek and Roman learning finally spread their treasures during the Renaissance, and from this time onward the pictographic "literature" of heraldry became obsolete. The fact that an uncleanly, brutal, spirit-fearing savage must be the ultimate termination, does not today, and apparently never has, deterred explorations of one's family tree. Heraldry seems to be almost from its inception a tremendous stimulus to looking backward. Aroused by prideful as well as economic aspirations to be numbered among the feudal nobility, the Englishman has nearly always been prone to ransack the past. But the frantic quest could not be fruitful for everyone, and in the fourteenth century the peasants revolted, shouting the shrewd query "When Adam delved and Eve span, Who was then the Gentleman?" This problem was perhaps no less nettlesome to medieval sages than determining the number of angels that could be accommodated on a needle's point. One theorist set all fears

*Herald literally means "servant of the army." But his function exceeded the mere announcement of tournaments. During the Middle Ages many of the official secular records were in his keeping.

at rest by deciding that "Adam bore a red shield upon which the arms of Eve, a shield of argent, were quartered as an escutcheon of pretense, she being an heiress." A later commentator dryly remarks that the emblazonry was probably carried on their fig leaves.

Heraldic zoology

As a rule, the escutcheon animal shows a rigid stylization of the primitive's usual indifference to naturalistic detail. He may be portrayed as rearing, standing, springing, walking, or merely lying down *(couchant)*—the technical designation being given in French participles. Sometimes the beast is "armed," that is, with teeth and claws showing, or "langued" (tongue showing), or any of a number of other prescribed postures, all bearing very little relation to the natural history of the animal as we know it today. For example, cranes appear standing on one foot, while, most unscientifically, holding a stone in the other. They became symbols of vigilance on the theory that whenever they dozed the stone splashed into the water and woke them. Pelicans were emblematic of sacrifice because of the myth that in time of scarcity their young were fed on the mother's own blood. When shown plucking at her breast, the pelican symbol is designated by the decorous phrase, "in her piety."

A tremendous range of stylized creatures has been devised upon the coats of arms of the new world, where porcupines, wildcats, squirrels, bees, grasshoppers and many American birds were suggested by the new environment and have taken their places beside the "nobler" exotic animals. As for the latter, leopards are frequently lions with the mane removed, and tigers often have the bodies of lions and the heads of wolves.

The fish which seems to appear most frequently is the dolphin. This typifies the large number of symbols that do not stem from the primitive forests but are for the most part taken over from the cultures of antiquity, including that of the Israelites. Despite this people's taboo against graven imagery, Jacob gave "totem animals" to his sons when he blessed them, and in the Book of Numbers, the Children of Israel were commanded to arrange their camp, each man "by his own standard, with the ensign of his father's house."

In the Hellenic world, the dolphin was long looked on by sailors as an omen of good fortune. It symbolized the maritime power of the Greeks and appears in the epics of Homer. Early Christian iconography reveals the creature as a symbol of the resurrection due to the fact that at death its body rapidly passes through all the colors of God's promise, the rainbow. But for most people the symbol is associated with the Dauphins, heirs to the throne of France. The fleur de lis is also an ancient symbol probably derived from the Egyptian lotus, and its popularity among French royalty is thought to be due in part to its tri-flowered emblem of the Holy Trinity. Nazi Germany may not have gone directly to the Orient for the swastika, since the figure appeared quite early in European heraldry. But in its original ancient Asiatic setting, this symbol represented the four points of the compass and the journey of the sun.

When knighthood was in flower

Many exotic animals found their way to medieval shields during the crusades. The ostrich was one of these and is a clear case of a wholly primitive attitude. The bird was regarded as swift and belligerent and so hardy that it was often depicted chewing keys, nails and horseshoes—possibly the origin of the colloquial hyperbole of some years back "so tough he chews horseshoes and spits nails" and doubtless an attribute sought by all knights who adopted the ostrich as their "fetish." Others who chose the elephant did so in the belief that this creature could not bend its knees and was, therefore, a token of royal supremacy. But the most sensationally primitive symbolism produced by the crusades were the pictured heads of Turks and Saracens. Women's heads also appear, and even skeletons, all of which point to a bloody trophy-art little different from that of Melanesian head hunters. However, not every grim device can be attributed to the holy wars. The Lichfield family, whose Saxon name literally means "field of corpses," had a rendition of the same emblazoned on their shield apparently for no reason beyond indulging a rather ghastly sense of humor. The "pun device,"—that is, the use of a fox to signify the Fox family —reveals a curious cycle often found in the arms of the leading families. Originally the names were, of course, taken directly from the animal. Then as heraldry came into vogue, the animal was in turn derived from the name, more or less in a spirit of fun.

War-whoops

National heroes have been awarded special insignia in nearly all cultures, and the custom extends into such heraldic symbols as stylized fortresses bestowed by monarchs for distinguished bravery during a defensive siege. Militarism and heraldry are everywhere closely allied. Medals and kindred tokens of achievement have ramified from early to modern soldiery and thence into civil life. The chevron, indicative of army rank, is most likely taken from primitive picture writing wherein water is frequently indicated by broken lines. Support is lent this theory by the fact that many towns situated on the banks of rivers still carry the chevron in their coats of arms.

Like warriors in other primitive cultures, the early Europeans had their war-whoops which have been dignified in literature by the French transcription *cris de guerre*. Many of these survived as family mottoes, although the term "motto" was unknown in heraldry's heyday. A noble referred to a slogan as his "Word" or "Reason." Anyone familiar with the cabalistic utterances of primitive people will at once recognize the tell-tale ring of magic in this terminology. The "Word" commonly gives its possessor a supernatural power over his enemy. It may also be of service as a verbal charm to banish evil. "Reason" is probably used here in the sense of "cause" or *raison d'être*.

The earliest war or rallying cries are supposed to be merely the name of the leader. Others seem to have originated as boasts of some sort of achievement. For instance, the grisly, "I Mak' Sicker" apparently brags of further mayhem on an already wounded enemy — or kicking a man when he's down. On the other hand, the cries frequently had no significance whatever except as a raucous hoot to scare the enemy. The Irish mottoes "A Boo" and "Alala," which are placed in all sobriety on various escutcheons, doubtless belong to this latter classification. Some similar interpretation seems likely if we are to make anything of the startling injunction inscribed on the arms of the Dakynses of Derbyshire, "Strike, Dakyns, the devil's in the hemp!" The same applies to the rather haunting admonition of the Martins of Dorsetshire, "He who looks at Martin's Ape, Martin's Ape shall look at him."

A case of importation from the ancient world was found in the motto of

one family, *Non bos in lingua.* This literally means "No bull on the tongue." However, in the light of classical history, it does not appear to be a stout denial by one accused of exaggeration in speech. The Greek coin, the drachma, bore the insignia of a bull, from which the term came to symbolize money generally; hence, *non bos in lingua* is judged to mean a tongue that cannot be bought.

The celebrated *Dieu et mon Droit* does not, as some people have thought, mean God and my Right Arm, but was the statement of Edward III's pretension to the throne of France, a claim which, incidentally, remained associated with English royalty for several hundred years and was not formally withdrawn until 1801.

The "bar" sinister

Since early heraldry was often consulted as a means of proving claims of inheritance, some device was required to designate illegitimacy. Of these, the baton sinister* is certainly the most famous but by no means the only one, nor even the one most frequently encountered. In order to keep the record straight, it was simply necessary for an illegitimate son to alter or "difference" the family coat of arms in some way to indicate the improper circumstances of his birth. Illegitimacy was not, however, absolute. Much depended on the degree of recognition which a father was willing to bestow on a son, and the Church was frequently called on to rectify matters long after the fact.

Many people are unperturbed by the presence of such symbols on their arms, preferring a tainted escutcheon to none at all. But others have caused no little confusion to the science of heraldry by all manner of attempts to expunge the stigma from their shield. A great deal of this went on during Elizabeth's reign, when a certain amount of misinterpretation of the past and a garbling of the old devices occurred through the ministrations of slipshod or venal copyists. And, in recent times, one young widow of title combined her arms with those of her lamented husband, only to learn that his family was descended from Charles II, all of whose children were born out of wedlock and were, therefore, obliged to bear testimony of the misfortune on their coats of arms. Rallying from the shock, the widow ordered this evidence struck out—whereupon the meaning of the entire symbolism collapsed and she was miraculously shown to have married the merry monarch several generations after his death.

Some authorities regard the present symbol of the British barristers of Temple Bar as a spurious offshoot of the ancient ensign of the Knights Templars. The latter organization was bound by an oath of poverty and accordingly used the figure of two knights riding one horse, apparently to designate an economy measure. The barristers, on the other hand, had less humble aspirations and chose to transform the indigent noblemen into a pair of wings.

The frequent instances where old symbols have been "whitewashed" to conform with the aims of their later adaptors is almost always attributable to human vanity. This same vice would seem to be responsible for the pomposity which marked the decadence of heraldry after Elizabeth and also for some of the arrant pretension in the furniture of our own grandmother's day. Kingly thrones have from earliest times been graven with the images of warlike beasts. This motif dates at least from the early Mesopotamian civilizations and was still present in the drawing rooms of the past century where animal heads and claws were brandished from the arms and legs of chairs and sofas.

Modern instances

It is recalled that the Spanish nobility were at one time accustomed to adopt the lowly pig for heraldic purposes. Here was surely no primitive attempt to gain the characteristics of the creature portrayed, rather it was a mark of defiance, since both Jews and Moors, then plentiful in Spain, placed a taboo on this animal. One may venture that a subsidiary purpose was to lay incontestable claim to a purely Gentile ancestry and, in this light, it is noteworthy that heraldry has been of considerable assistance to the English and American wives of Germans who were called upon by the Nazi government to demonstrate their "Aryanism."

Today the study of armorial bearings has grown so complex that only a highly trained expert can read their meaning with any degree of accuracy. One of these declares that perhaps no more than six English families now extant can trace a clear descent from the time of William the Conqueror and that anyone who purports to have discovered a Saxon ancestor may be discounted as an impostor.

Yet the custom goes on and is seemingly developing new aspects and fresh innovations almost daily. There is perhaps no activity more emblematic of modern life than the innocent hobby of private flying which, though still in its early stages, seems already on the road to its own heraldry. Many private flying machines bear a coat of arms intended to individualize their owner; and one may hazard that a new College of Heraldry will eventually come into existence for the purpose of guaranteeing the various aviation crests against the inroads of "low born" upstarts. In cases where these new "flying families" already possess a genealogical coat of arms, this will probably be incorporated into the latest symbol of aristocracy. Knights

Continued on page 192

*Technical heraldry frowns on the use of "bar," which it regards as a misnomer popularized by "novelists." Baton or baston seem to be preferred for reasons too complex to be dealt with in this article.

THE TALL TRUTH

LIVING ON BORROWED AIR

While many kinds of air breathing animals have learned to go under water for various purposes and for varying periods of time, it is to the water spider that we must turn for real perfection in this ancient diving game. She can stay under water for hours and days—even sleeps and raises her young down there. How does she manage to stay under so long? By a method almost too novel to be believed.

First of all, she spins a broad airproof web down under the water, fastening it at each end between the stems of water plants. This web is to be her living quarters and must be filled with fresh air from above. How? Madam Spider knows. When her web is properly anchored, she comes to the surface, thrusts her hinder parts and back legs into the air with a kind of clutching motion, then drags them quickly under again, thus catching a bubble of air on her hairy legs and body. Next, down she goes to the web and, coming up from beneath, releases her bubble of air, which remains under the web, then back to the surface she travels for another. As the amount of air increases, its buoyancy lifts the elastic and loosely stretched web into a kind of sac closed at the top and open at the bottom. Into this magic chamber Madam Spider crawls and remains as long as her air supply lasts, even hanging her eggs there from its ceiling. Eventually, however, when her air supply becomes vitiated, she cuts a hole in the top to allow it to escape, finally repairing and refilling the chamber for further use.

Has this queen of divers left anything to us by way of originality in going under the water?

Roy L. Abbott.
Professor of Biology,
Iowa State Teachers College.

YOUR NEW BOOKS

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INDIANS OF THE U. S. • MEMOIRS OF A PALAEONTOLOGIST

AMERICAN MAMMALS

- - - - - - by W. J. Hamilton, Jr.

McGraw-Hill Book Co., $3.75

NATURE lovers and students will find Hamilton's new book on *American Mammals* a welcome addition to biological literature, for it brings within the confines of a single volume a mass of data which has hitherto been scattered among many volumes. Special emphasis is given to ecology, the adaptation of mammals to their environment, and the economic relations of North American mammals. Their habits are outlined in general terms, and peculiar features of behavior, peculiar in that not all mammals so behave, such as hibernation and migration, are described.

It is not possible in a single book to give an exhaustive treatment to a field as large as that which Hamilton has chosen, but a carefully selected bibliography at the close of each chapter will serve to guide the reader on a search for more details. For many readers the author's selection of the salient facts will suffice and the book will be a very useful reference.

The geographic scope is from Panama to Arctic regions and the treatment is by family groups in the chapter on classification. With his mammals organized within their proper groups, Hamilton then plans his chapters to develop the special topics mentioned above, namely, adaptation, hibernation, migration, etc. The economic importance of mammals is an important theme to which several chapters are devoted, useful mammals, injurious mammals, game mammals, fur-bearing mammals and predatory mammals. The author has been schooled in the principles of true conservation and urges that full study be given to all of the factors involved before passing judgment upon any species of mammal; mammals injurious under some circumstances may be beneficial under others, as exemplified by the snowshoe rabbit, an animal which may need control where trees are being planted, but a much-desired game species in the next county.

The book is well illustrated with halftones and line cuts.

H. E. ANTHONY.

A FORGOTTEN RIVER, A Book of Peruvian Travel and Botanical Notes

- - - - - by Christopher Sandeman

Oxford University Press

THIS is a diary of an English gardener and botanist written on a three months' journey in search of plants in Peru. The narrative is mainly concerned with the Huallaga River, a tributary of the Amazon. The literary quality is higher than that of most diaries written under similar conditions, and it is the more interesting because of the author's familiarity with Spanish and Spanish American history, and his thorough knowledge of botany.

The river journey was partly by dugout canoes, but mostly by the more comfortable rafts made of the lighter-than-cork balsa logs. The book contains readable accounts of the life of the Quechua Indians—their ability to carry heavy burdens through the tropical jungle, feats "compared with which a British soldier's stiffest march with a heavy pack is child's play"; the plaiting of Panama hats; the chewing of cocoa leaves; the belief in signs of the Moon; the gathering of ivory-nuts, which in the early stages can be eaten and of which in certain localities the Indians make a beverage from the thin, pulpy coat covering the nuts. We are reminded that the Latin scientific generic name of the ivory-nut palm, *Phytelephas,* comes from the Greek word for *plant* plus the word for *elephant,* an appropriate name, for, as the elephant furnishes animal ivory, so this palm furnishes vegetable ivory.

Several new species and one new genus of plants were found. The new genus was described in the Kew Bulletin by Dr. H. A. Gleason of the New York Botanical Garden. Doctor Gleason, a recognized authority on the plants of northern South America, named the genus *Sandemania,* in honor of Mr. Sandeman, a fact which the author modestly neglects to mention.

Besides descriptions of vanilla and other orchids—many of them showy—we have experiences with beautiful parrakeets, leaf-cutting ants, and vampire bats. The author encounters a party of American naturalists, and one wonders who they were.

The book is illustrated with two maps and about thirty photographs. The latter, although good and of interesting and well chosen subjects, make one wish that the author was as good a photographer as he is a botanist.

CLYDE FISHER.

ECUADOR
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UNKNOWN

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A highly informative and readable account covering two and one-half years of travel in Ecuador and the Galapagos islands. The author gives a fascinating picture of the country, its people, plant and animal life. Numerous and beautiful illustrations. $3.50

OXFORD UNIVERSITY PRESS
114 Fifth Ave., New York

THE THRONE OF THE GODS

- - - - - - - by Arnold Heim and August Gansser

Macmillan, $5.00

IN writing upon the little known mountains of the Central Himalayas, the authors made a contribution to mountaineering books and set an example for others to follow. Dr. Arnold Heim, the senior author and leader of the Swiss Himalaya Expedition, has been for many years the outstanding geologist of Switzerland. His assistant, August Gansser, appears to be destined for equal eminence. While the expedition was primarily concerned with solving a few of the geological problems, this popular account deals with their experiences and mentions only incidentally the scientific discoveries.

The authors possess unusual powers of observation and broadness of interest which give them a greater insight into the life of the natives and all the interesting forms of plant and animal life, the live species as well as those preserved and studied in the rock foundation. The botanist will be pleased to find the Latin names of the plants observed; the entomologist to see an indication of the native Lepidoptera and their abundance; and the general reader to gain in knowledge of the geography, physical and social, of Northern India, and a portion of Tibet.

The immediate impression is that here is a beautiful book, and an examination of the numerous fine photographs of a

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INDIANS
OF THE
UNITED STATES
by Clark Wissler

Illustrated. $3.75

DOUBLEDAY, DORAN

region of overwhelming grandeur, reproduced in photogravure, confirms that thought. In a pocket at the end, a relief map, probably the most accurate yet made of this region, shows the topography of the area and the intricate route of the geologists. The expedition proved that this mountain mass, the youngest of all mountains, has Alpine structure and is still rising far faster than erosion is lowering it.

The translators, Eden and Cedar Paul, are obviously unfamiliar with geological terms, but this is of small importance, for the geologically trained reader will readily understand what is meant, and most readers will read and enjoy it for its general interest, to which the geology is extremely incidental. For *The Throne of the Gods* is fine reading, even for those who only look at pictures.

F. H. POUGH.

THE INDOOR GARDEN

- - - - - - - by Daisy T. Abbott

The University of Minnesota Press, $1.50

THE trial and error method has long been the rule which many people have followed, in their attempts to create more cheerful abodes, by harboring plants in their midst. The results of their labors, unfortunately, have usually been short lives and sickly ones, for the plants.

In this book details are given that when followed may bring a happier ending for the plants, for between its covers is information regarding some of the results of Mrs. Abbott's successes in raising various house plants attained over a period of about twenty years.

You may find that you have had some wrong theories concerning plant propagation. For instance, this statement—"If you have no radiators in your house on which to start your cuttings you will be forced to use your ingenuity." And most people say they cannot grow plants because all their windows have radiators under them—imagine their chagrin when they read that they "must have a radiator to use as a stimulant when propagating plants." Or, what about this one? "Geranium slips should be left on a table to dry for an hour or more after being taken from the plant." In case you do not know the answer, that is just a little trick to prevent rotting before the plant bas time to set roots.

You do not need a greenhouse nor the legendary "Green Thumb," you just choose the proper plant for your situation from among the many examples. You do have to use judgment in caring for it but the formula given for each plant should make for pretty clear sailing. Such advice as: put no water in the crown of a cactus; let no water get onto hairy leaves; be careful about wet feet at bed time; use this solution to kill red spiders or that one for plant lice; soak that "Gift Plant" as soon as it arrives; don't let cold breezes blow down their spines, may very well add up to healthy, and probably blooming plants.

Among the topics discussed are: Foliage Plants; Flowering Plants; Gift Plants; House Plant Troubles; Propagation; Spring and Summer Care; Gardens under Glass and Gardens in Apartments, Schoolroom and Office.

FARIDA WILEY.

Continued on page 191

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LETTERS—*Continued from page 129*

SIRS:

I enclose check for $1.50. Please send me the new binder. I know of no other magazine except the *Scientific American* for which I would go to this trouble; but your numbers are too valuable to lose.

CHARLES GRAEF, M.D.
New York, N. Y.

* * *

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ALEX VAN RAVENSWAAY, M.D.
Boonville, Missouri

* * *

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. . . I also want to tell you how much I enjoy this magazine and how valuable it is to my biology classes.

JEAN LOUISE WILLIAMS.
Dana Hall School,
Wellesley, Mass.

* * *

SIRS:

. . . This NATURAL HISTORY Magazine is a wonderful publication and it is a great help to us in the Museum.

RUTH CORBETT.
City Museum,
Vancouver, B. C.

* * *

SIRS:

. . . Down here on the desert where mail is delivered but twice a week, mail-day is something to look forward to. But there are ten days a year when the mail brings something extra-special, which is your magazine, every bit of it being digested as though it were the last morsel of food possessed by a starving man.

WILLIAM KLAUS.
Wikieup, Ariz.

* * *

SIRS:

. . . A friend has been reading my NATURAL HISTORY Magazines after I finish them, and he recently informed me that this was the most interesting work he had ever had the pleasure of reading, and wanted to become a regular subscriber.

A. J. RAHN.
Lewistown, Montana

* * *

SIRS:

Congratulations on that excellent article, "The Story of Coffee," by Dean Freiday, which appeared in your December issue. . . . Mr. Freiday has done an unusually good job of research and has brought a freshness to the presentation of an old subject which adds much interest to it.

CLAYTON N. WATKINS,
Chief Publications Division.
Jewel Tea Co., Inc.
Barryington, Ill.

SIRS:

Please refer to your January issue, 1940, page 52. Isn't the picture at the bottom of that page, entitled "Wild Boar and Babies," misnamed?

Think it over!

J. D. STEELE.
Commission on City Plan,
Baltimore, Md.

Mr. J. D. Steele is obviously correct. The title should have been "Wild Sow and Babies." Had the title been correct, the photograph would indeed have made news.—ED.

NOTICE: Readers are encouraged to submit their own photographs of natural history subjects. Those selected for publication on this page will be paid for at $1.00 each, with full credit to the photographer. Return postage must be included.

THOROUGHBRED PHAR-LAP. A figure modeled by Robert H. Rockwell of the American Museum of Natural History, which was awarded First Prize in the recent exhibition, The Horse in Art

Continued from page 189

INDIANS OF THE UNITED STATES

Four Centuries of Their History and Culture

- - - - - - - - - - by Clark Wissler

Doubleday, Doran and Co.

ALL Indians used to be classified as either bad Indians or dead ones. This harsh and embittered judgment prevailed wherever white pioneers were engaged in wresting from their Indian predecessors possession of land. Only after the struggle had ceased with the banishment of the Indian, did a more tolerant and even romantic conception replace the earlier view. Thus it was along the eastern seaboard where European settlements first became secure that the notion of a noble red man appeared at a period when Indians still were anathema to the white men moving into their territory to the west. Curiously enough, by the time the eastern populations, secure and uncontested in their ownership of the land, were prepared to take this more generous position with regard to the Indian, the memory of the local tribesmen had already dimmed, and it was necessary to borrow models from regions farther west. In this manner a national Indian endowed with war bonnet, tepee and horse was created from a local western type and clothed with romantic attributes.

This mythical creature, preserved by literary tradition, conforms neither to the pre-European aboriginal nor to the frontier Indian, who was in reality his inspiration. The pre-Columbian Indian, in all his infinite variation, has frequently been the object of anthropological investigation. He has even appeared in more popular writing. But the tragic story of the frontier Indian has been strangely neglected both by the specialist and the public.

It will, therefore, come to many readers as a revelation to read this account of the history of the Indian in contact with the expansion of the white settlements of the United States. Few men are as admirably equipped as Dr. Clark Wissler to tell the tale. Long experience with living Indians, a life time of scholarship devoted to a study of their culture, and a sympathetic understanding of their anomalous position lie back of this portrayal of Indian-white contact.

It is not generally recognized that the Indians who figure in our colonial annals and later in our westward march were a dislocated people leading distorted lives for which our aggressive frontier was responsible. The thin line of our advancing frontier disrupted the economy upon which Indian life was built and continually forced the aborigines to move westward to escape encroachment. Once an Indian tribe was uprooted it rarely achieved thereafter any permanency. Constantly fighting to save its means of livelihood, betrayed again and again by the United States Government, these desperate and valiant Indians either were eventually exterminated or reduced to virtual degradation on reservations. The record is a disgraceful repetition of betrayal and misunderstanding.

Doctor Wissler has vividly and sanely set forth the major lineaments of this tragic epic. He has filled an important gap long left vacant. And with the *Indians of the United States* he has furnished a correction to a misconception of long standing.

H. L. SHAPIRO.

SOME MEMORIES OF A PALAEONTOLOGIST

- - - By William Berryman Scott

Princeton University Press, $3.00

PROFESSOR SCOTT, classmate and intimate friend of Henry Fairfield Osborn, the late President of The American Museum of Natural History, gives us here the chronicle of a long and fruitful life.

Born February 12, 1858, Scott entered Princeton at 15, received his Ph.D. degree from Heidelberg in 1880 at 22 years of age, and the same year was appointed to the faculty of Princeton University. Here he served for fifty years, retiring in 1930. During the past ten years he has been very active, as professor emeritus, in the preparation of a number of scientific reports, notably a series of monographs on the vertebrate faunas of the White River Oligocene, the horizon in which Scott and Osborn worked in their first western expedition in 1877.

Scott has known many great scientists and educators and his descriptions of Huxley, Balfour, Gegenbaur, Osborn, Cope, McCosh, and Wilson, to mention only a few, will serve to aid many to whom they are but authors and legendary figures, to better understand and interpret their works.

Throughout all the book there runs, of course, the story of vertebrate palaeontology, of early collecting expeditions in the West, of trips to museums in many parts of the world, and, especially, of the men who lived the science during these years.

The book is, according to a statement in the preface, "a greatly reduced version of an autobiography which I wrote as a family record for my children." In places it suffers greatly by the reduction, and at times the continuity of the story has been entirely lost. An example of this occurs in the description of the expedition of 1891. "For some time we went wandering about in search of the fossil beds . . . it began to look as if we should have to go home without having found a place to begin work." (p. 182) Then, "So far as we could judge, we had about exhausted the possibilities of our two localities. For their size I never saw any beds so rich." (p. 183). The probably dramatic story of the discovery of these localities, and of their contents is not given.

Despite such examples of too enthusiastic reduction, we have here an eminently readable story of a full life replete with the serenity and satisfaction of ambitious programs planned and accomplished.

H. E. VOKES.

INFORMATION TEST

A few informational high spots that may be gleaned from this month's NATURAL HISTORY

Score 10 points for each correct answer
Correct answers on page 192

1. What large island south of Australia is named after the Dutch navigator who discovered it?

2. Is a Maori
   (a) two-footed
   (b) four-footed
   (c) six-footed

3. Nazi Germany is responsible for the first appearance of the swastika in European symbolism.
   True..... False.....

4. The North Star is becoming a "better" north star because it is
   (a) becoming brighter
   (b) getting closer to true north
   (c) drawing nearer the earth

5. "Chattering like a magpie" is pure folklore. This bird does not share the parrot's ability to approximate human speech.
   True..... False.....

6. The American dollar sign was invented by the first Continental Congress.
   True..... False.....

7. If you point your camera at the North Star and leave the shutter open, will the star photograph as a
   (a) point
   (b) straight line
   (c) curved line

8. Though many air-breathing creatures go under water, none makes its home there.
   True..... False.....

9. Who is the most famous kleptomaniac among birds?

10. Do stars "rise and set"?

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THE STORY OF HERALDRY

Continued from page 187

may no longer go forth to battle sheathed in gaudily emblazoned coats, but the day seems not far off when the heavens will resound with the motors of private airplanes, the more pretentious of them bearing the official symbol of its owner. For man has always contrived some such art-symbol of his more adventurous activities since the days of cave dwelling.

Indeed, the heraldry of the air has already established its precedent. During the first World War, it was found necessary to distinguish the battle planes of different armies and divisions of armies. The American ace Eddie Rickenbacker, had painted on his plane a disc showing a glossy silk ringmaster's hat, symbolic of his leadership of the famous Flying Circus. Thus a cycle of Europe is completed wherein the modern knights of the air rally their followers to ensigns as did the helmet crests of Crécy and for that matter the ensigns of the Roman Legions.

It seems fairly certain, however, that the religious and totemic aspects of blazonry are gone forever. To sum up the modern view, we need perhaps look no further than Jane MacNeal's dictum "With the Indian, blazonry is a religion. With the [casual observer] it is at least history. To some it is a most difficult art or science. To many, it is a joke, and to the English College of Arms, it is doubtless all of these and also a source of revenue."

D. R. Barton.

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Answers to Questions on page 191

1. Tasmania, named after Tasman, who discovered it in 1642. See page 133.
2. (a) Two-footed. A Maori is a New Zealand native. See page 133.
3. False. The figure appeared quite early in European heraldry. See page 184.
4. (b) Getting closer to true North. The North Star will reach its "best" position in 2100 A. D. See page 129.
5. False. Captured at an early age, magpies may be taught to talk. See page 183.
6. False. This device seems to have originated from a ribbon-entwined design on the Spanish dollar widely used in Colonial America. See page 184.
7. (c) Curved line. See page 129.
8. False. See page 187.
9. The magpie. All objects that glitter are particularly attractive to this bird. See page 180.
10. Yes. The rotation of the earth on its axis causes the stars, like the sun, to "rise and set." See page 129.

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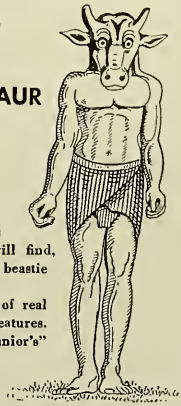

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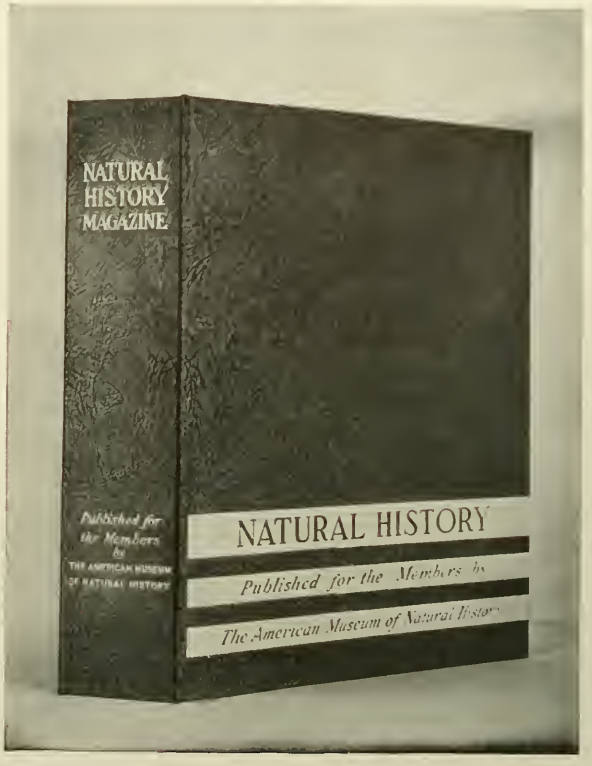

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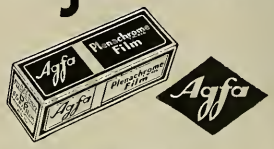

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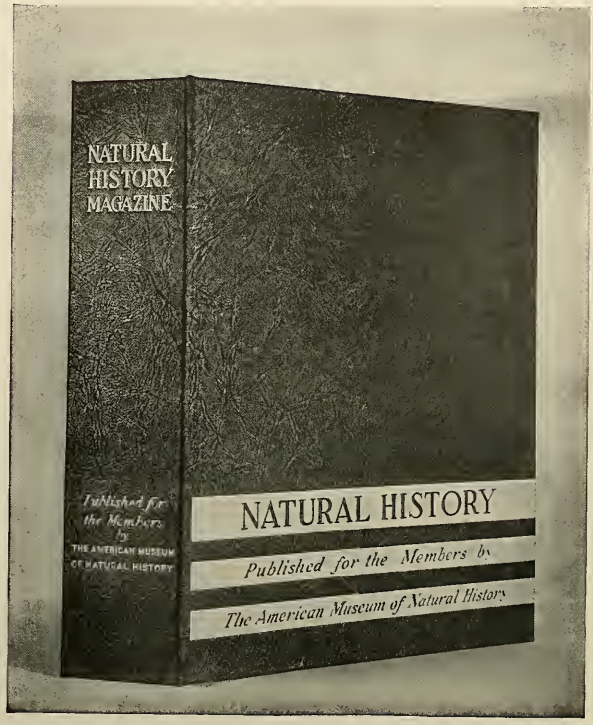

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Natural History

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Above illustration from Bird Group of Hudson Bay Region in the American Museum of Natural History

LETTERS

SIRS:

Since I am a photographer for the museum at Mammoth Hot Springs, Yellowstone National Park, I had the opportunity to take the accompanying photograph of an albino buffalo. The animal is on the National Bison Range near Moiese, Montana.

When I came upon the scene the albino was reclining at the top of a small knoll, where he could overlook the rest of the herd. He is a bold animal, and at the sight of us he came unhesitatingly forward down the side of the hillock, the others following him more uncertainly. The photograph I was thus able to get shows what a magnificent bull he is. He is pure white and has red eyes. But there is something else strange and, one might say, diabolic in his appearance. A great shaggy mass of black hair crowns the top of his head.

His parents were normal buffalo, his mother being an exceptionally fine specimen of a cow. He will be seven years old this spring, according to George E. Mushbach, Superintendent of Refuges.

The same cow gave birth to a true albino buffalo in 1937, sired by the white buffalo in this photograph. The albino calf, however, was born blind, and is now in the National Zoo in Washington, D. C.

It is believed that there is one other white buffalo in existence: a white calf seen last year ranging in Alaska by a Bureau wildlife agent. The present Alaska herd descends from 23 buffalo transported from the National Bison Range to the Territory in 1928 and now numbers something around 200 head.

Other than these three, white men knew positively of two other white buffalo in the early days; and there are Indian legends of three or more others.

W. PEYTON MONCURE.

Gardiner, Montana.

SIRS:

As a footnote to your most excellent "Story of Heraldry" in the March NATURAL HISTORY, did you know that the liveries of our present chauffeurs had a proper foundation in the old English clothing of the retainers in which the cloth was the color of the ground of the shield, the trimmings agreed with the main device and the buttons with the small bosses?

This matter of color, most important in its day for distinguishing retainers, is now generally lost sight of in informative papers.

M. D. FOLLIN.

Dunedin, Fla.

* * *

SIRS:

I am delighted with your New Zealand story, "An Evolutionist Looks at the Maoris," by William K. Gregory, which appeared in the March, 1940, issue of NATURAL HISTORY Magazine.

Strangely enough, and quite by coincidence, on page 190 of this same issue there is a modeled figure of the horse Phar-lap, the model having won for Robert H. Rockwell a first prize. It so happens that Phar-lap was the New Zealand born horse who came to this country and met his death shortly after his arrival. New Zealanders adored Phar-lap and still speak of him in hushed tones, so this particular issue will certainly interest New Zealand readers.

NOLA LUXFORD.

New York, N. Y.

* * *

SIRS:

I have found the NATURAL HISTORY Magazine a source of great pleasure and real benefit. I have also enjoyed a number of trips to the Museum and feel that residents and visitors to New York City should be very grateful to those whose efforts have created and maintained such a fine institution. . . .

(MRS.) ELIZABETH K. SERRALLES.

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VOLUME XLV—No. 4 ★ ★ ★ ★ ★ ★ APRIL, 1940

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Photograph by Henry B. Kane

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IN THE LAND OF

NASHI SACRED SCROLLS. *Studying these rare pictographs, Quentin Roosevelt traces Buddha's journey through hell. The completion of one of these scrolls used to require six months' work by a skilled* dtomba, *who remained in a religious trance. The art has long since disappeared and these scrolls are now seldom seen. To secure them author Roosevelt trekked through China to temples of once-feared devil priests*

Karger-Life photo

THE DEVIL PRIESTS

A one-man expedition to China's inaccessible and forbidding hinterland secures ancient pictographic scrolls which reveal the heretofore obscure history of the secluded Nashis

By QUENTIN ROOSEVELT

Two years ago my mother and I spent a month in China. She had been ill, and always refers to the visit as "Grandma's Rest Cure." In that short space of time we traveled over 3000 miles by plane, we had several narrow escapes from death by air, by water, by shellfire and by bombs, we became refugees, and we ended with a severe earthquake in Manila.

After my return to the States I became interested in some curious scrolls and manuscripts that my father had brought back from western China. They had been stored in the attic for ten years, but my recent trip to China stimulated a new curiosity about them. I learned that they had been painted and written by the Nashis, a people of whom practically nothing is known. The writing is pictographic and bears no relation to any other known writing, past or present. These scrolls and books reveal a civilization over 1000 years old that reflects many of the cultures with which it came in contact, and which have since disappeared. Today the Nashis, what is left of them, live on and around the plain of Li-kiang between two 12,000-foot mountain ranges in a little loop on the upper Yangtze River. Their actual beginnings are obscure and can only be guessed through their unreliable histories. They are generally supposed to have left their original homeland about the time of Christ, and journeyed down the Mekong Gorges and eastward until they finally settled where they are now. Here they lived a more or less independent life until the advent of the Chinese magistrates some 500 years ago. They still have a hereditary king who has a certain amount of pomp but no power.

Several articles have been written about these interesting people and their literature by Dr. Joseph Rock, but so far as I could find the only specimens of their books in any museum were a few given to the Fogg Museum in Boston by my father, and a collection at the Congressional Library in Washington. Because of their scarcity various other museums became interested and offered to contribute to an expedition that I was willing to undertake to collect as many as possible.

On March 4, 1939, I left Seattle and after incidental adventures in bombarded China found myself, within scarcely more than a month, gliding down upon the city of Chungking, far in the interior.

After a stay of a few days in Chungking I had the opportunity of meeting W. L. Bond, head of the Chinese commercial airline. One evening Bond took me aside and said, "How would you like to fly up to Lanchow?" I was interested for several reasons, first because there was no regular airline to Lanchow, and second because it is probably the most difficult place in the whole of China to get permission to enter. Bond went on to explain that in a day or so a special military Douglas was going on a trip for the Military Aviation Commission. It would be flown over an unusual route, directly over the Tsinling Shan between northwest Szechwan and southwestern Kansu, and in easy sight of the Amnyi Machin, a huge unsurveyed mountain range of northern Koko Nor, which when sighted about two decades ago by Pereira, the British explorer, was heralded as a possible rival to Mt. Everest as the world's highest mountain.

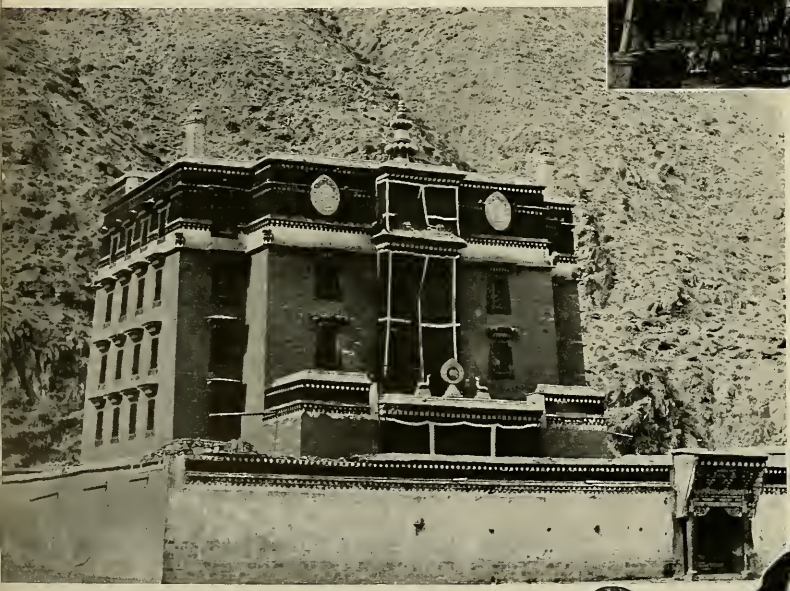
Since Lanchow is one of the most powerful air bases in China, no foreigners, except a few Russians, have been allowed on the airfield, and I anticipated difficulty about permits. With Dr. Kung's help, however, a visa was quickly granted. General Mao, of the Aviation Commission, was consulted, gave his consent, and said that the plane would leave the next day. At six o'clock the following morning I was at the airfield, and shortly afterwards we took off.

Our first stop was Chengtu, which was as far as my mother and I had gone two years before. Here we refueled and hopped off again, but after a short time were obliged to return to Chengtu because the clouds were too high for the plane to climb over them.

(Right) FORCED *by poor flying conditions to remain in Chengtu, Roosevelt made the most of his time by purchasing Tibetan curiosities such as the sacred manuscript held by this Tibetan lama*

(Left) AMNYI MACHIN—*a challenge to the ambitious mountaineer. This huge unsurveyed mountain range of northern Koko Nor had previously been heralded as a possible rival to Mt. Everest as the world's highest mountain*

(Right) A MODERN STEEL BRIDGE *spanning the Yellow River at Lanchow. Beneath this relatively modern structure float primitive goatskin rafts, the only means of navigation. The bustle of the new and the old in this faraway Chinese city does not hide the significant fact that Lanchow is one of China's most powerful air bases and consequently one of the most difficult places in all China to enter*



(Left) THE ABODE *of a living Buddha. Monasteries housing monks of various sects offered excellent hunting grounds for the author in his search for ancient Nashi scrolls. Although monks chanted from sacred books and displayed Tibetan sacred banners, devil masks, and many other things, they were generally unwilling to part with these possessions*

(Right) A LIVING BUDDHA *in his ceremonial robes. Although Tibet is ruled by one living Buddha supreme, the Dalai Lama, there are a number of local Buddhas*

Since many of the peaks in this region are uncharted and above 20,000 feet, it is unwise to proceed in a fog on dead reckoning, so we were forced to spend the night there. As the next day also was bad for flying high, I spent the morning buying skins—snow-leopard and golden monkeys and Tibetan lynxes—also some Tibetan manuscripts and bronze vessels. While I was there I saw a delightful baby giant panda, recently captured west of Chengtu.

The next morning we really did get started and climbed to about 19,000 feet. Here we had a perfect view of the big mountains in eastern Tibet and Koko Nor. Far to the southwest was the Minya Konka, glimmering faintly with its sheen of snow, while directly to the west were other snow-covered peaks. As we got farther north an enormous bulk of white mountains with crowning twin peaks gradually came into view. Much higher than the surrounding ones, this was the famous Amnyi Machin, unsurveyed and exceedingly high. As we sailed along over the white blanket of clouds, an occasional peak would poke its head through directly beneath us, and I was glad we were above it.

Shortly after noon we began to leave the high mountains and clouds and crossed a wide stretch of snowy grassland, which tapered off into abrupt little mountains, gorges and occasional emerald green lakes. There were no trees on the yellowish gray mountains, and the only signs of life were numerous walled fortresses placed at strategic intervals on the cliffs. All at once we found ourselves over the narrow basin of the Yellow River, with Lanchow lying below us, hemmed in with sharp dusty hills. As we came down I could see the goatskin rafts, the only means of river navigation.

I was met at the plane by a representative of the Foreign Ministry and a representative of General Chu Shao Liang, the military governor. The latter invited me to stay at his residence, an impressive place which had been the palace of a Ming prince. It had seven courtyards with a large garden at the rear against the massive city wall. This section of the city wall is supposed to be a section of the Great Wall of China, which runs through Lanchow and out to the northwest. My room was directly against the Old Wall, and in the garden outside were two police dogs and an assortment of wild animals in bamboo cages, including bear, wildcat, deer, fox, leopard, etc. Two sentries were on guard.

My stay in Lanchow was spent in driving about the city exploring the suburbs, and crossing the Yellow River. The city itself is very old with some characteristics of North China, and some Mohammedan. There are many Sino-Mohammedan mosques and everywhere in the streets can be seen the long faces and prominent noses of the worshipers of Islam with traces of Caucasian blood. In the streets a common sight is the blue "covered wagon" hoods of two-

(Right) A STUPA, *or memorial shrine, near Lanchow, which reveals the architectural influence of Tibet*

(Middle right) A SECTION *of the new Burma road over which many supplies and munitions are transported from Rangoon to Chiang Kai-shek's government*

(Right) POSSIBLY *antedating the travels of Marco Polo is the tribute road which may be seen in the background*

(Left) ALTHOUGH *this young Tibetan sported an old-type revolver, he evidently felt that a charm box was necessary to combat the miscellaneous devils of the Tibetan world against which bullets have no effect. Roosevelt found that the little charms in such a box were considered sacred and not for sale*

(Below) TWO STREET SCENES *in the ancient city of Talifu, which lies beside the smooth highway of the new Burma road. In far southwestern China, within 100 miles of the Burma border, this ancient city was once a Mohammedan capital. About a decade ago an earthquake devastated prosperous Talifu, sparing little of it from ruin except a well-built city wall and a few imposing gates*

wheeled carts pulled by horses, while more unusual are the beautiful rickshas with purple and silver cloth cushions and silver butterflies inlaid in the body. All the rickshas in the city seem to be made in this fashion and I do not remember seeing a single one that was shabby or dirty.

After I returned to Chungking, I started out along the Burma road in a new Buick sedan lent me by Mme. Chiang Kai-shek's brother, T. L. Soong, whose Southwest Transportation Company sends caravans of trucks over this road from Rangoon, carrying supplies and munitions to Chiang Kai-shek's government. I was traveling with a Mr. Liao of the Company, who was to accompany me the whole way, acting as an interpreter.

We stopped the second night at Talifu, once an ancient Mohammedan capital, which was devastated by an earthquake about a decade ago. Little remains now of the once prosperous city except a few imposing gates, a well-built city wall, and a sea of ruined stone houses. The surrounding plain is inhabited almost entirely by an ancient tribe called the Minchias, different from the Chinese who live in the city itself, both in language and customs.

In Talifu I enjoyed a comfortable night at the China Inland Mission. The next morning I went around with Mr. Wagner of the Pentecostal Union, to the Chinese magistrate to go through the necessary red tape and formalities and at the same time presented my credentials for an armed escort. Shortly afterwards I discovered that General Sheuh Wha, to whom I had a letter, was in town. He is the Commander-in-Chief of the unsettled northwestern section of Yünnan, and is a man of considerable power. I found him to be pleasant and kindly. He told me that he was going to Li-kiang in a few days and invited me to go with him.

Off we went two days later, I astride a huge mule provided by the general, and he riding in his large chair, carried by four coolies marching in single file. Its roof was covered with black and red cloth and its sides were equipped with mosquito-netted windows. The arms of the chair had silver knobs, and the chair itself was covered with a large Tibetan wolfskin. A tiny police dog puppy was the general's constant companion in the chair and divided its time between yelps of boredom and a deep sleep in the old man's lap. The swinging of the conveyance made it impossible for the little dog to stand up, and it sat most of the time with its legs straddled, looking confused. I was amused to hear the chair-coolies cursing at the extra weight of the dog, and singing songs in Chinese, explained to me by my interpreter, which would have shocked the general if they had been in a dialect he could understand.

The general was an extremely kindly man and a pleasant traveling companion. He neither smoked opium nor drank. He was not fond of exercise, and often admitted that he would much rather sleep in his chair than ride his stallion. That he was a man of action, however, was shown by his past record in dealing with bandits, as he had never been bested by any of them in a fight. He was a firm adherent to the Lamaistic cult of the Red Cap, and often spent several days in retirement in the monastery of Wen Feng Sse near Li-kiang. Later, when I visited that monastery I was shown a photograph of him in prayer, with a strange protuberance coming out of his head. Although the monks were convinced it was a holy manifestation, I am sure it was a defect in the lens.

(Below) PACKING *up the caravan to press on by pony into a territory where Buicks fear to tread*

(Below, right) GENERAL SHEUH WHA, *a powerful figure in Yünnan, who accompanied the author into the interior. He rode in a sedan chair with silver trimmings, his constant companion a tiny police dog puppy*

(Above) WINNOWING *grain in the streets of Niu Kai, a village near the heart of a bandit-infested district*

(Below) TWO NATIVES *operating a primitive grain mashing machine. Daily life went on in Niu Kai although 150 brigands had been causing trouble in the surrounding hills*

We arrived at Shi-tso late the same night, where we stayed at the elaborate house of Mr. Yin, a merchant who lived half of the time in Shi-tso and half in Li-kiang. Our beds consisted of boards on saw horses, but I had become accustomed to this by that time. At dinner I had a slight shock when I discovered that one of the dishes consisted entirely of caterpillars, considered a great delicacy in these parts.

Two days later at Niu Kai a tall, gaunt Chinese captain came up and saluted the general. He was in charge of the bandit suppression activities in the surrounding territory, and had come to make his report. With him came some of his half-Tibetan troops, dressed mostly in furs, who stood respectfully in the background as the general and his captain had a council of war. Apparently there were some 150 bandits who had been creating trouble recently in the hills around Niu Kai.

After much consultation it was decided that we should continue with a tripled troop escort through the dangerous country. Niu Kai had often been the scene of battles between Chinese troops and bandits, in which the general had taken part. Once he took the city from the famous bandit, Chang, and he showed me the exact spot where he had beheaded him.

I was walking beside the general and telling him, through an interpreter, of the wonderful things to be seen in America, when suddenly an old woman rushed from the crowd and flung herself at the general's feet, weeping and beating her head on the ground. Her son was in one of the bandit groups, and she was imploring mercy for him. The general said that he would give her son three days to return to the fold, but if, at that time he had not returned, he would not be spared. On my return trip I was told that he was still with the bandits.

Most of the day the general seemed worried. He told me afterwards that he was carrying a large number of banknotes to the forces of Li-kiang, and was afraid for their safety.

(Left) AN EXAMPLE *of religious statuary in a Niu Kai temple. Beyond this village Quentin Roosevelt proceeded with triple troop escort*

(Right) A FORTIFIED HOUSE *near Hsai Ping*

(Right) THE AUTHOR'S *pony caravan threading along a mountain pass beyond Talifu. Two passes of about 12,000 feet impeded progress to Li-kiang, where the ancient documents were sought*

(Below) THE MARKET *place at Yoso. The people are Minchias, an ancient tribe differing from the Chinese in both language and customs*

(Below) THE PORTALS *of a town on the expedition's itinerary*

(Below, right) A DOWNHILL VIEW *of the "one-pig" town of Kwang Shan, where the author slept among chickens, horses, cows, and goats, with rats scurrying around under his cot*

At Chien Chuan, a walled town similar to Talifu but smaller, we stayed over night at the treasury, where I ate my first fried locusts. They were rather good, with supposedly high nutritive qualities, and reminded me of shrimps.

The next day's stage was a short one, and we spent the night in a little one-pig village called Kwang Shan. After being met by the village headman in his bare feet, we put up at a little peasant inn. We slept in the same enclosure as the chickens, horses, ducks, cows, pigs and goats, to say nothing of the inevitable rats that scurried around under my cot and ate some biscuits hanging on the wall in a little bag near my head.

Too steep to ride

At four o'clock in the morning we arose and started on the longest and most difficult stage of all—90 li (30 miles) across altitudes of about 12,000 feet to Li-kiang. We started off by walking up an incline too steep for the horses to carry us, until we overlooked the entire valley of Chien Chuan and the pass to Niu Kai far beyond.

After a few hours riding along the top of the ridge, we began to drop down until it became so steep we again had to abandon our horses. We stopped for lunch at La-She-Ba, a little village halfway down the slope. Here I saw my first Nashi women, with the curious goatskins hanging on their backs and the nine brilliantly colored disks attached to the hairy side of the skin. I noticed for the first time the difference between the Nashi and Chinese women. The former seem less Mongoloid in general appearance, and are on the whole better looking from an Occidental point of view. Their figures, dumpy and shapeless to a degree, are accentuated by the voluminous and unflattering garments they wear.

The Nashi town of Li-kiang is an ancient settlement and probably existed before the Nashis conquered this land at the time of Christ, when they migrated from Chong, a city north of Atun-tse, and settled in and near the plain of the Li-kiang— "Beautiful River." For several centuries their *yamen* or king ruled here undisturbed, until the Chinese took over. The streets are passably clean, and beside all the larger ones run little streams, confined neatly between banks of fitted stone. The streams, spanned at intervals by little stone bridges, are so clear that the neatly laid pavement of stones on the bottom could be seen, although the current was swift. The houses in general resemble the ordinary Chinese house, but at each end, coming vertically down from the apex of the roof at the ridgepole, is an intricately carved board about four feet long, supposed to keep out devils. At the bottom of the piece two fishes are represented. No Nashi I spoke to could explain the meaning of the carvings on this board, and all I could gather was that the general effect was beneficial.

One of my father's friends, Mr. James Andrews, was in charge of the Protestant Mission in Li-kiang. He had spent almost 20 years in the Nashi country and knew perhaps more about the Nashis than any other living man, and I hoped he would be able to tell me how to go about finding the Nashi manuscripts and scrolls. We discussed the possibilities of collecting in and around Li-kiang. I was disappointed, when at first he seemed pessimistic about my finding any books and scrolls. These old documents, as I have said, are extremely rare and scientifically important because almost nothing is known of the Nashi people whose history they reveal. Furthermore, the art of making the books has died out, and the scrolls which used to take a skilled *dtomba* six months to make while in a trance, are scarcely ever seen now. The writing, unlike anything known elsewhere, resembles superficially the ancient Egyptian hieroglyphics, but it has a certain action and humor that separates it at once from anything so stylized. The characters, at first glance, look like a child's picture book, a sort of Mickey Mouse. There are many little drawings of cows, horses, birds, tigers, dwarfs, and strange gods, that show a vigorous and refreshing artistic style.

I was exceedingly anxious to collect these books and scrolls because they often tell in the course of recitation the history of various Nashi heroes. They are the sacred manuscripts of these people and also contain charms to find lost objects, services for a dead farmer or his cattle, and other chants sung in innumerable rites and ceremonies.

Difficult to buy

Mr. Andrews said that for many years the pictographic books and especially the long painted scrolls had been extremely rare and because of this the priests, or *dtombas,* would be unwilling to sell any of the books or scrolls they might have. However, he promised to send for a *dtomba* he knew and to commission the latter to go out into the country and buy up everything he could. No Nashi manuscripts could be bought in the city of Li-kiang itself.

The *dtomba* arrived and proved to be an old man with large, simple features and a spinachy beard. He seemed fairly optimistic about getting what I wanted and agreed to be back with whatever he could find in a week.

One of Mr. Andrews' missionary workers came in to tell us that he had located a priest who had a quantity of pictographic books, also paraphernalia used by *dtombas* during ceremonies, and one of the long scrolls.

The local general invited us to a dinner. About four in the afternoon his bodyguard came to tell us that the feast was ready. The custom was to inform the guests a couple of hours in advance, and then at regular intervals afterwards. We finally went when the bodyguard appeared for the fourth time with a brilliant "Petromax" lantern, which was carried ahead of us in the gloom.

The dinner at the general's house was a small one for about eight people, but it was beautifully cooked and he had some good French wine. I strongly suspect that the wine was pilfered from a foreigner's caravan and then offered for sale in the streets of Li-kiang, but anyway it was excellent. A phonograph played Chinese music in the distance, and the various progeny of the general scrambled over everything to watch the feast for the *Wai-Kwerin,* or foreigner.

Since our worker had no luck in finding either scrolls or manuscripts, we definitely made up our minds to go ourselves the next day. We left on horseback directly after breakfast and headed west across

the plain. Han Hai-tze, as the place was called, was an hour's ride out, at the edge of the basin. The ride was a lovely one. To the north, the Snow Mountain rose in all its glory with no mist to obscure its jagged bulk. The upper half, from about 12,000 feet up, was covered with snow, and stood in sharp contrast to the green of the valley. I stopped next to a little temple and a stone bridge crossing a stream to take a picture, and our horses chose that moment to run away in opposite directions. After fifteen minutes of breathless plunging through paddy fields and creeks, we secured them again, and started off towards the *dtomba's* village, now only a mile or so across the meadows.

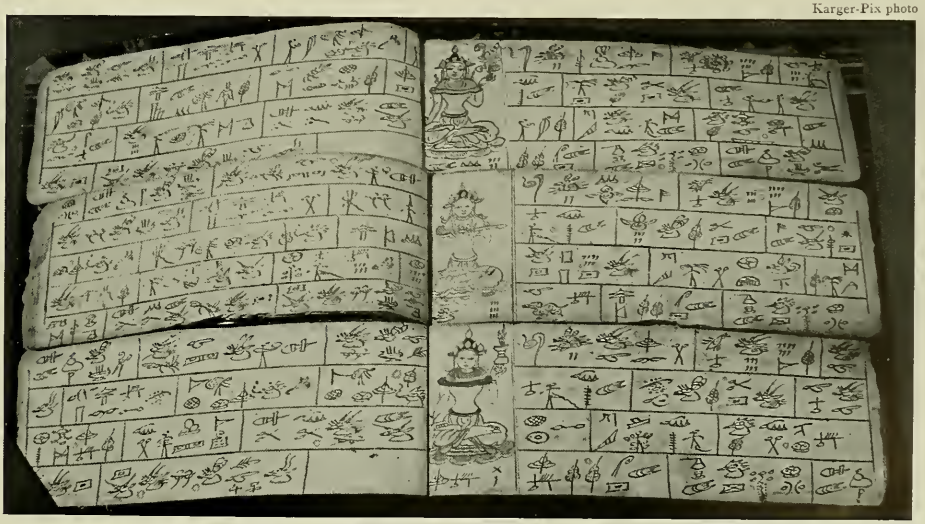
The priest's house was one of four or five in the village, and consisted of a stable and living quarters, forming a small court, all made of mud. The old *dtomba* himself greeted us and went up to get his books and possessions. They were all lying about in an extremely musty old loft, with rats eating them and making nests in them. We brought them into the light and began to bargain for them. Gradually we reached an agreement about everything except one set of books which he was planning to use in a ceremony the next day. Unfortunately his long scroll was lent to a friend, since they were very scarce, and he didn't expect it back for a week. He was willing to sell us a crown and some sacred banners, and, on considerable

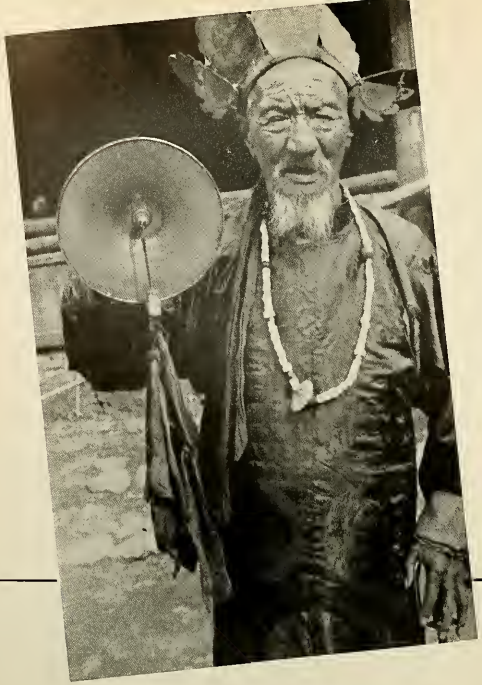
(Above) At Li-kiang *("Beautiful river") the expedition began the long negotiations to secure the sacred documents relating to Nashi history. The region was captured by the Nashis at the time of Christ*

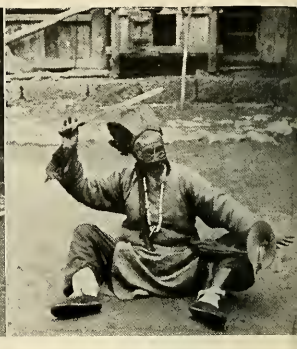
(Above) James Andrews, *missionary friend of Mr. Roosevelt's, with two lamas*

(Below) One *of the sacred books. The writing, unlike anything known elsewhere, superficially resembles ancient Egyptian hieroglyphics*

Karger-Pix photo







(Left) A 70-YEAR-OLD dtomba *or devil priest of the Nashis suddenly announced that "his tiger was coming up"*

persuasion, the set of books he wanted to use, but no amount of persuasion would make him sell his bronze cymbal. We finally left, having sent about 200 books and other acquisitions back to the mission on the back of a coolie woman.

The next day we started to the south end of the plain, at the same time sending one of the Nashi mission workers to a small village ten miles to the northwest to collect what he could, but this was a fruitless trip as the *dtomba* we sought was away. For a change we were on foot on stone-paved paths running between the fields. In an hour we got to the southern edge of the basin, and after passing through a group of neat little houses, we stopped at one that stood off by itself. Mr. Andrews' knock at the door brought no response, and we went in. An old woman told us that the *dtomba* had gone over to La-She-Ba to confer with the magistrate about the destruction wrought by a recent hailstorm on his crops. Since everything of interest was locked up in the loft, we could do nothing but start back to Li-kiang.

The next day we made another trip to this priest's house and waited for him an hour or so. We were on the point of departing when he appeared in the distance with a disciple. Millet wine had made him affable and extremely hospitable. With much ceremony he asked us in, offering to kill a chicken for us. We refused politely and sat down on some rude wooden benches in the yard. His eyes were very poor, and he wore spectacles made of ordinary window glass in the vain hope that they might improve his vision. I imagine he must have been more than 70 years old, and he had a long beard, which he stroked meditatively while considering a price.

He showed us one by one his crowns, scepter and ceremonial sword. While doing so he suddenly got the urge to dance. Holding the sword in one hand, and a beautiful bronze cymbal in the other, he announced gravely that his "tiger was coming up." He then went through a perfectly amazing series of contortions and gesticulations, quite a different man from the feeble old peasant of a few moments earlier.

A sharp old Nashi woman stood in the background, and made bargaining difficult by always putting up his prices and quarreling with his decisions. She would allow him to part with his possessions only when we offered him two pairs of dark glasses to boot. Even at that we discovered he had lent his scroll to another priest, and again our main object was thwarted. We bought some books and a scepter, however, and went back to the town. He promised to bring us the scroll in a day or two.

Mr. Andrews suggested that we visit one of the Buddhist monasteries in the hills around the plain, and we decided on Wen Feng Sse, a large monastery of the Red Cap sect to the southwest. We let out our Tibetan stallions and tore across uneven ground, bridges, creeks and canals, until we reached the hills. A few minutes later it began to rain, and we stopped at the mud house of a farmer. There was scarcely room for the three horses in his courtyard, but we finally managed, with my horse tied up in the cook house and the other two in the yard. The first thing that happened was that Mr. Andrews' horse pulled out the doorjamb to which he was tethered, causing part of the roof to fall down on about a hundred newly-made earthenware pots, breaking most of them. While we were doing our best to disentangle the horse, roof, door, and pots, my horse took fright in the cook house and almost kicked the side out of it. After everything had quieted down, the third horse, tied in the center of the court, laid down and rolled with its saddle on. Mr. Andrews whacked it with his stick to make it stand up again, but in so doing the horse broke its reins and dashed out of the courtyard. Finally it was caught.

We left the farmer's house and rode on towards the monastery. It was in beautiful surroundings and apparently very old. As soon as we entered the mon-

(Above) SPRY *for his years, the devil priest went into a wild, spontaneous dance as a prelude to selling his sacred books*

astery grounds we found ourselves on a well-tended greensward amid huge pines. A pool made of large blocks of stone lay a short distance in front of the steps leading up to the first gateway. This led into a large open courtyard, flanked by a cloister, and closed at the far end by the main prayer temple. We rode our horses through the first gate, and then into another courtyard on the right, where several of the monks were sitting, working on hats for the novices.

One of the monks took us around to the main hall of worship, and unlocked the big doors. Inside the walls and ceilings were covered with intricate colored painting and Tibetan sacred banners. There were some paintings made of butter, curious things of various designs stretched on thin frames and hung from the ceiling. We climbed up some rickety old stairs to the cupola to see the devil masks, heads of black devils, red devils, deer, pigs, old men, and many other things, which we tried unsuccessfully to buy.

When we came down it was raining and the light was very bad indeed for photography. We visited one of the monks in his cell who was chanting a Tibetan sacred book and beating time on a cymbal and drum. Sometimes they chanted all day without changing their position, and I wondered what their books said and whether they got any interest out of it.

We had heard that there were three men at this monastery who were being initiated as lamas, spending three years, three months, three weeks, three days, three hours, three minutes and three seconds in a cave. During this time they were not allowed to see or speak to another human being. I was curious to see in what sort of place they lived. The monks told us they were on top of the mountain near the house of the *hofu* or abbot of the monastery. Since we hoped to get some prayer banners and charm boxes from the *hofu,* we decided to climb up there.

It was raining hard. We missed the path and spent most of the time on our hands and knees going through thorns and brambles, but we finally found the place and went in. We were not allowed to see

(Above) ENTRANCE *to a monastery near Li-kiang*

(Below) THE AUTHOR *examining prayer wheels which are set up in the interior*

the prospective lamas, but we could hear them chanting and blowing on their horns. They were in a little building over a natural cave, which had no windows or other means of ventilation or light that I could see. The *hofu* was affable but had nothing to sell us. All we got for our trip was a very fine Tibetan dagger from one of the guards.

Evening found us back at the mission, where we were met by a pleasant surprise. The mission worker, whom Mr. Andrews had sent to the northwest the day before, had returned with one of the long scrolls complete. At least part of my quest was now successful.

Four different *dtombas* visited us the next morning. The one we had commissioned to go out and buy for us returned with several books and a few Nashi paintings, but no scroll. We put him to work immediately sorting out 1000 or so books I had acquired by this time. Another priest arrived, with one of the long scrolls, a very good one, and we closed the deal quickly. I wasn't going to let a scroll get into my sight and out of it again. The third *dtomba* appeared with about 300 books, and we bought them after a short altercation about the price. This one also had a cymbal and four or five painted crowns he wanted to sell. Luck was certainly with me that day. The fourth priest was the old man from the southern edge of the plain, and he had brought his long scroll, but it was a very dilapidated and incomplete one, so we let it go.

That same afternoon the mission worker appeared with over 700 more books. Most of these books are made up of 20 or 30 pages about a foot long by four inches wide. Usually the drawings are made with a shaped bamboo twig, and there are two different scripts. One, the She-lu or pictographic writing, is of obscure origin but is believed to have come from the individual drawings of the Tibetan Bon-pa or demon cult. The other, supposedly introduced at a later date, is said to have been invented by Gurba, one of the disciples of the Nashi messiah, Timba Shihloh.

Several elements in one of the scrolls indicate that the Nashis drew parts of their belief from the south, Vedic Indian and pre-Buddhist Burma. Therefore, the study of these people reveals not only interesting facts about their own theology, but also throws light on the little-known faiths from which it drew its form. Some of their gods are elephants with 33 heads, white wish-granting Garuda birds with red beaks and wings, and great dragons with spiked-trees coming out of their mouths, on which are impaled sinful Nashis.

The road of the dead

Some of the scrolls are 40 feet long by eight inches wide. There are generally used for funeral services and are called Hä Zhi P'i. They represent the road the soul of a dead man must travel to reach heaven. He must first pass through purgatory where various ugly demons seek to restrain him from going any farther. If he is lucky and has committed few sins, he may ascend to a serene and thickly populated heaven. Often the scrolls are cut in two lengths, and the priests refer to the sections as "The Road to Heaven" and "The Road to Hell." Appropriately enough, the road to hell is short and easy, while the road to heaven is long and arduous. The rendering of the Nashi heaven resembles, in the later scrolls, the style of the Tibetan temple hangings, while the hell scenes seem closer to the Burmese paintings.

In former times the "devil priests" who perform the Nashi religious ceremonies held a strong hand over the people, but their power is fading rapidly in the face of Christianity, Buddhism and general indifference.

Mr. Andrews very kindly turned over to me most of the collections he himself had made during the past years. These included many Lolo, Tibetan and Nashi things, all exceptional. There was a large conch shell trumpet mounted in bronze and used by the *dtombas* in their ceremonies, a human thighbone trumpet used by Tibetan lamas in their devil dances, and an unusually good Tibetan charm box complete with charms. These charms are very curious. Usually the Tibetan will remove them when and if he sells the silver outer box. This box contained little figures made from the clay of dead lamas, also funny little seeds supposed to be the beads of perspiration from the brow of Buddha in meditation, and a long cloth, with brown handprints on it, supposed to fit the hands of future incarnations of Buddha. Among the Lolo things was a curious board, covered with strange writing and the picture of a devil, supposed to keep devils out of the house. Since ethnologists until recently have known little about either the Lolo writing or their theology, this board may prove most interesting scientifically. Needless to say I was very glad indeed to get these excellent collections, which ordinarily would have taken me years to acquire.

Tales of robbers

Mr. Andrews told me many tales of his travels in the country, through Tibetan and Lolo territory where few white men dared go. He told me of the tortures inflicted by the Lolos on the Chinese. No Chinese can go through Lolo territory and come out alive. He is either killed or taken prisoner and made a slave. After one woman was taken prisoner, large iron spikes were stuck through her feet and hands to prevent her running away. The Chinese magistrate who was to take charge of Yung-peh, the largest city in the Lolo country, was waylaid en route to his post, and his wife was shot. The Lolos are famous robbers, and they will sit in their watchtowers atop the hills and descend on any caravan that looks fat and rich. I heard in Li-kiang of two French priests that were seized and skinned alive by the bandits. The whole northwest territory of Yünnan is unsettled. Atun-tse, a city northwest of Li-kiang, is invaded and sacked by Tibetans at intervals, and the women and children in the streets are knifed.

After spending ten days in Li-kiang all my missions were accomplished. I started back by caravan. In Talifu I collected a Minchia bridal costume—a great success—after which I piled my numerous boxes into a little bus provided by the Southwest Transportation Company and was off again. Beyond Talifu we roared along the fine highway and it was hard to realize that a scant decade before there had been a civil war raging between armies based at Talifu and others based at Yünnan-fu.

At Yünnan-fu I picked up my furs and other Tib-etan collections, and started south toward Indo-China. Mr. Patou, head of the railway, very kindly provided a private car for me and my luggage, and the trip down was both comfortable and interesting. It took me three days by the slow train, and I saw much more of the spectacular railway than I had on the way up.

I felt much relieved and thoroughly satisfied when I finally was settled on the *Empress of Canada* with my cases, which numbered fifteen by that time, headed for the United States, my journey over.

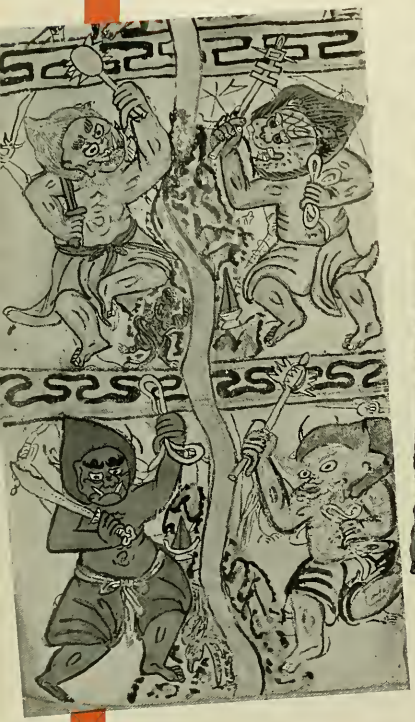
THOUGH *the Nashis dwell in China, their historical documents indicate a previous relation with pre-Buddhist Burma and Vedic India*

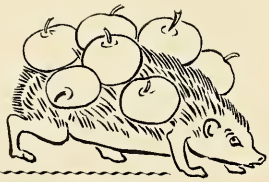
(Below) THE BEGINNING *of a funeral scroll, showing two of the nine pairs of demons guarding the entrance to hell. The "Road to Hell" is short and easy, the "Road to Heaven" long and hard. In "escorting" the soul on its proper course, the priest places a moulded piece of dough on each demon figure to win its good graces*

At left is shown the oldest scroll in the author's possession, dated between the seventh and the thirteenth century. It shows Nashi gods sitting in their higher heaven

(Below) THE SACRED *33-headed elephant in the city of the 33 princes: a scene almost exactly the same as that in the philosophy of pre-Buddhist Burma*

Karger-Pix photos





SPEAKING OF ANIMALS

By JAMES G. NEEDHAM

". . . and carrieth them home to his den"

They gave primitive man half his words and contributed some of the most picturesque expressions in the King's English

". . . to prevent rain from entering into his nose"

ANIMALS are not like other things in this world; they are like us. They forage and fight, they play and sleep, they make homes for themselves and provide for their broods, moved by the same instincts that are the springs of our own conduct.

It is not strange, therefore, that in primeval times man saw in the beasts that were most familiar to him, beings so like himself that he attributed to them like thoughts and feelings, like passions and prejudices. Primitive man lived much closer to the beasts than we do now. We have shut ourselves indoors, where we see very little of them—only a few pets in the household, and a few draft animals in the streets. But he lived in daily association with them, and in a communion of spirit that we can hardly realize.

He treated them as persons, like himself, with kindred ideas of benefits and injuries, and with capacity for sympathy and anger. Like himself they had immortal souls. He must, therefore, pay proper regard to their rights. Indeed, his own spirit might in another incarnation animate a beast; he might be one of them.

Although he must kill some of them, he did it with due regard for their feelings. Concerning the Iroquois hunter, for instance, Lindquist writes: "When a bear had been killed the Indian knelt down beside it and built a little ceremonial fire upon which he cast tobacco incense. He would then address the spirit of the bear, seeking to curb its anger at having been slain. 'O brother bear, do not be angry: I needed your skin and your flesh for I must have clothing and flesh to eat. The Great Spirit has made both of us but he has made man more cunning. I have not slain you for malice or for mere sport, so be not angry. I should not have been angry had you slain me. Come, accept my sacrifice. See, I cast aside the arrow that killed you; see it burn. See, I give you these beads and this knife; accept them as my gifts to you, and invoke no harm to me.' "

Strange animals run through the pages of the zoological books of the Middle Ages, or "bestiaries," as they are called. They were curious mixtures of fact and fancy. Mythical animals were treated with the same seriousness as real ones. Gorgons and griffins, centaurs and minotaurs romp along with deer, rabbits, and mice. They were equally believed in. They were not only described in great detail; they were pictured. Some artists then as now were gifted with vivid imagination!

These mythical beasts will be forever with us, for their images have found permanent lodgment in our art and in our literature. Until the beginning of this century the great dragon adorned the flag of China; the unicorn is still in its accustomed place on the seal of Great Britain.

Mythical notions about real animals have been even more widespread and persistent. Some animals furnished charms. Their teeth, spurs, claws or plumes, if worn, conferred on the wearer their powers of combat or their cunning. Necklaces made from the teeth of dangerous beasts have been greatly prized as protective devices; and many a gizzard stone or rabbit's hind foot is carried in our own land today for good luck.

Some animals were "unclean," and therefore could not be eaten. The uncleanness was merely ceremonial, having nothing to do with the nutritive value of their flesh.

Some were ancestral, different animals in different tribes of men; the founders of the tribe were descended from them. Images of these animals were often placed on totem poles in front of tribal dwellings, as by our Alaska Indians.

Some animals were sacred: the cat in ancient Egypt; the cow and the monkey in India, where cows roam the streets and monkeys swarm in the public parks; the snake in Nigeria, etc. They could not be killed under any circumstances or molested in any way. They must be worshipped and allowed entire freedom.

Sir Harry Johnston cites a remarkable form of piety which allowed the python to pass anywhere unmolested in Nigeria. This enormous snake, like the American boa constrictor, kills its prey by crushing it in the coils of its own powerful body, smearing it with saliva and then swallowing it whole. Sir Harry says, "If a python seized a child in the street in its coils and commenced to slaver it with its viscous saliva, the mother, so far from interfering to save it, must stand by and call out her thanks and summon

". . . accounts for his rubbery nose"

"The grapes are sour, and not ripe as I thought"

All drawings by Joseph M. Guerry

her friends and relatives to rejoice with her that the python god has so honored her family as to devour her child."[1]

The snake has been held sacred the world around by many different tribes of men. It is a truly marvelous creature, well calculated to stir the imagination of the fanciful. In the lore of ancient Egypt it was said to be heavy like the earth and slippery like water. Its scales were numberless like the stars. Its skin was put off each year and annually renewed like the seasons in an eternal succession. It could travel with incredible freedom and celerity of motion, *moved by its spirit,* having no hands or feet. In Egypt the universe was pictured as a snake swallowing its own tail—a symbol that is still not uncommon in our art.

The first literature that our race possessed appears to have been beast tales. These may be roughly grouped into four principal categories: simple stories, stories of talking animals, whyfore tales, and fables.

1. Simple stories about animals, based on the observations and on the fancies of primeval times and told for the sake of telling, had no other purpose than entertainment. In the process of retelling, these often suffered amendment and expansion, as fish stories do in our own day. Here is a story about the hedgehog from Edward Topsell's *Histories of the Foure-footed Beasts* (1607):

"It is about the bignesse of the Cony, but more like to a Hogge, being beset and compassed all over with sharp thorny haires, as well on the face as on the Feete. When she is angered, or gathereth her foode, she striketh them up by an admirable instinct of nature, as sharpe as pinnes or needles. . . . His meate is apples wormes and grapes. When he findeth apples or grapes on the earth he rowleth himself upon them until he have filled all his prickeles, and then he carrieth them home to his den. And if it fortun that one of them fall off by the way, he likewise shaketh off all the residue, and walloweth upon them afresh until they all be settled upon his back again. So, forsoothe, he gooeth, making a noise like a cart wheele. And if there be any young ones in his nest, they pull off the load wherewithal he is loaded, eating thereof what they please and laying up the residue for time to come."[2]

In early Chinese literature there is such a story about the big Kweichow monkey *(Rhinopithecus)* with a funny turned-up nose.[3] In it occurs this descriptive paragraph:

"Its nose is turned upward, and its tail is very long and forked at the end. When it rains, the animal, to prevent water from running into its nose, thrusts the fork into its nostrils."

The author did not deem it necessary to explain how the monkey breathes while it rains.

2. Stories of talking animals are known to all. No one who was brought up on the children's books *(Little Red Ridinghood,* etc.) of the generation now passing from the scene will lack for illustrations of this class of animal stories. One of these, the great medieval beast epic, *Reynard, the Fox,* held a foremost place in the early literature of the chief languages of western Europe. It was so widely known and so highly appreciated that the Germans called it the *Unheilige-Welt Bibel,* or secular-world Bible. But its anthropomorphic hero, Reynard, was a conscienceless beast, with no merit except the feral virtue of cunning.

One story of a talking beast is preserved for us in the *Bible,* the allegorical tale of Balaam's ass, that after being three times wrongfully and cruelly beaten, protested:

"Am not I thine ass, upon which thou hast ridden ever since I was thine, even unto this day? Was I ever wont to do so unto thee?"[4]

3. Whyfore tales are stories that account for the strange physical peculiarities of certain animals, such as the elephant's trunk, the zebra's stripes, the bear's lack of tail. Kipling tried his hand at inventing such tales in his book entitled *Just-so Stories;* but they lack something of the full flavor of whyfore tales that have grown naturally in the primeval environment.

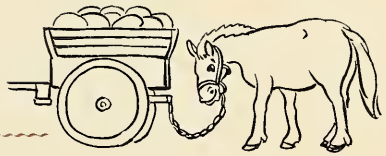
[1] Johnston, *The Story of My Life,* p. 186.

[2] Hulm, *Natural History in Lore and Legend,* pp. 168-9.

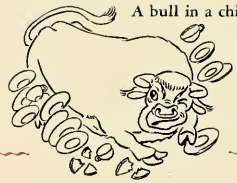
[3] When the French zoologist Milne-Edwards gave this monkey its scientific name, there was at the royal court a very popular young lady named Roxana, who had a tiptilted nose. He named the monkey for her, *Rhinopithecus roxanae.* It is not recorded whether she appreciated the compliment.

[4] Numbers, 22:30.

Putting the cart before the horse



A bull in a china shop



Professor A. W. Smith went further into the field of fancy, and had his animals growing on trees:

"Wherever an elephant grows
He's always hitched on by his nose
And he just has to wait
Till his weight is so great
That his nose is stretched out to a hose;—
That accounts for his rubbery nose."

Good examples of the real thing are found in the Uncle Remus books by Joel Chandler Harris: *How Mr. Rabbit Lost His Fine Bushy Tail; Why the Guinea Hen Is Speckled; Why Mr. Possum Has No Hair on His Tail;* etc. These stories have no purpose beyond affording the mental satisfaction that comes from knowing about strange things and having them satisfactorily explained!

4. A fable is a beast tale with a moral. The fictitious characters in it are animals. Each kind of animal has its own proper character, or at least the character popularly attributed to it: the fox is sly, the lion is domineering and the ass is stupid, slow and stubborn. The interpretation of the tale is always clear and undeniable.

Fables generally teach some social duty or some political truth. They embody the wisdom of the ages. They convey instruction under a merry guise in an impersonal way without seeming to preach. They are compounded of human experience.

Fables have had a large share in shaping public opinion in matters of manners and morals, and thus, in establishing standards of public and private conduct. Consider that ancient classic from the collection of Aesop, *The Dog in the Manger:*

"A dog lay in the manger, and by his growling and snapping prevented the oxen from eating the hay which had been placed for them. 'What a selfish dog,' said one of them to his companions; 'he cannot eat the hay himself, and yet refuses to let those eat who can.' "

There is another from the same collection that has a place in our language as an everyday figure of speech; in popular parlance abbreviated to "sour grapes."

"A famished fox saw some clusters of ripe black grapes hanging from a trellised vine. She resorted to all her tricks to get them but wearied herself in vain, for she could not reach them. At last she turned away beguiling herself of her disappointment and saying: 'The grapes are sour, and not ripe as I thought.' "

With what simplicity, brevity, clarity and telling effect these tales point out human foibles! What graphic representations they are of human attitudes of mind!

For more picturesque speech

Ethnologists tell us that more than half the words in any primitive language are derived from association with animals. The meager vocabulary of early man has become inordinately expanded in modern times, and mainly in the direction of abstract terms; but animal characteristics are still the basis of much of our most picturesque and effective speech. From past association with them are derived the words that convey our thought with the greatest ease and brevity and with more than graphic clearness. When the dictionary defines a grunt as a "low guttural sound" our notion of the sound intended is very vague until it adds "as of a hog." When it defines purring as "an intermittent murmuring sound," that doesn't tell much, but when it adds "such as a cat makes when pleased or satisfied," then we can almost hear it.

Figures of speech drawn from animals enter into our conversation in numberless ways. Similes in all possible forms abound. One may be mulish or hoggish or wolfish or, if of the feminine gender, kittenish. One may behave like a balky mule, or like a bull in a china shop, or like a snake in the grass, or like a fish out of water. One may be like an animal merely in some form of specific behavior: slow as a snail, quiet as a mouse, or scared as a rabbit; or one may stick like a leech, or kick like a mule, or laugh like a hyena. One may be following the scent, or merely playing 'possum.

Metaphors also abound. One may be called a monkey or a bear, or a worm, or a gazelle, or (again, if of the right gender) a butterfly of fashion. One way of meeting an opponent's otherwise unanswerable arguments is by calling him a jackass. The most prominent feature of one's face may be a snout, a

". . . an old rookery"

Mad as a wet hen

rooter, a beak, a proboscis or a pug. The old Cascadilla Hall on the Cornell University Campus, where most of the members of the faculty used to live, was called an old rookery. (I never lived there.)

Far more abounding are the single descriptive words drawn from animal behavior. Cat behavior, for instance, gave our language pussyfooting, mewing, purring, caterwauling; also such telling phrases as getting the fur rubbed the wrong way, watching at the mousehole, getting her back up (it is generally *her* back, I think, although I see no good reason for this, and I'm sure the behavior is not sex-limited). Successful emergence from a difficult situation is pictured as alighting on one's feet like a cat.

Chickens have suggested their share of meaningful words, and more than their share of practical maxims and proverbs. Such words as crowing, strutting, cockiness, and cocksureness; cackling, squawking, and brooding; cheeping and peeping; mad as a wet hen; and a henpecked husband. Much worldly wisdom is condensed in the following gallinaceous maxims:

Don't count your chickens before they are hatched.

With your eggs all in one basket take good care of the basket.

Birds of a feather flock together.

Chickens come home to roost.

The cow, besides being bovine, has contributed by her behavior the words bawling, bellowing, mooing, browsing, cud-chewing and horning. The sheep bleats, and is the mother of both the straying lamb and the shorn lamb; the wool may be pulled over her eyes. In her family there may a black sheep, and among her distant relatives there may be a scapegoat.

All the foregoing are familiar land animals. Aquatic animals also furnish good figures of speech; the whale for bigness, the eel for slipperiness, and the clam for extreme conservatism. The fish has contributed most, being best known; his small fry, his numerous spawn, his staring, lidless, "fishy" eye and his cold, elusive tail; all are useful when vivid comparisons are in demand. But it is fishing, rather than the fish, that has contributed most to the picturesqueness of our speech, especially fishing in the most ancient manner, with hook and line. The method by which a woman may get a husband has been illustrated from angling, the three stages being: (1) getting a rise out of him; (2) getting him hooked, and (3) getting him landed.

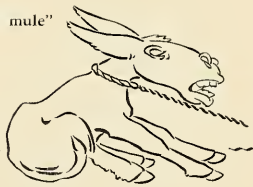
Because the horse and the dog have been longest with us as servants and co-laborers, they have perhaps given us the most figures of speech. Next come the cow and the hen. These are the two that have done most for human sustenance, providing food and the materials for clothing and for use in the arts.

Next come the cat and the pig, the one furnishing figures for contentment and agility, the other for bad manners.

Next comes the snake in all its kinds: adder, viper, copperhead, rattler; all of them hissing, coiling, slithering, showing poison fangs or a forked tongue; all carrying suggestions of evil. Next comes the bee in a dual role: delectable things suggested by its honey and unpleasant ones by its sting. After the bee come many other animals that have been known to the public for economic value or medicinal use or noxious quality, or for some very striking peculiarity of form or of behavior. Animals, big and little, of evil import are the stealthy tiger, the vampire bat, the mephitic skunk, the nimble flea and the dirty louse.

It was inevitable that a thing so important to mankind as the domestication of animals should leave in the language many symbols of their use. A conclusion in advance of evidence is putting the cart before the horse. A precaution taken after the loss has been discovered is locking the stable door after the horse is stolen. A matter in dispute is a bone of contention. An onerous duty is performed under the spur of necessity. A conquering hero is the man on horseback, and when well established he is seated firmly in the saddle. A colleague of mine complained of being saddled with the chairmanship of a committee: another, more elderly, says that he hopes to die in the harness: whereupon another says that he hopes to have a few rolls in the pasture first. A woman with an unbridled tongue has a husband who is always getting hot under the collar and a son who is held with a very loose rein, who when feeling his oats boasts that he is held by no man's halter. A lady who married a rather wild youth is said to have gotten him where he will stand

". . . like a balky mule"



Letting the cat out of the bag

without hitching. Another lady who will marry a widower is commended for getting a husband already broken to double harness.

All this sounds "horsy." But there is much more from the same source, and still more from the dog; for the dog has been in the past man's most intimate animal associate. Although all dogs may be regarded as domesticated, they are not all good dogs, and our language abounds in allusions to the bad ones as well: to curs, mongrels, whelps, bloodhounds, etc. One may sometimes sidestep trouble by heeding the ancient maxim, "Let sleeping dogs lie."

The percipience of the Great Teacher was never made clearer than in these words of his:

"Give not that which is holy unto the dogs, neither cast ye your pearls before swine, lest they trample them under foot, and turn again and rend you."[5]

The Promised Land was a land "flowing with milk and honey," the choicest of animal products. The patriarch Job, spoke of his vanished years of prosperity as of "days when my steps were washed with butter."

Every field of human activity is pervaded by language derived from such animal sources. Here are a few examples from politics: The hopeful candidate gets the presidential bee to buzzing in his bonnet; he appeals to the voters with spread-eagle oratory; when defeated he becomes a lame duck, and has to eat crow, and his last speech is his swan song.

In Washington it is stated that the holding companies have milked the corporations; also that they have hogged the proceeds. President Hoover complained of the locust swarms of lobbyists about the Capitol. Those seeking subsidies are as flies swarming about the honey pots. Money is earmarked for special ownership, as yearlings used to be marked when they ran the range. We often hear of political leeches and octopus corporations, and more rarely of the dove of peace. A bit of advice for overzealous reformers is, "Better not stir up a skunk unless you can kill it." How else could so much be told in so few words?

The party emblems are animals: two that have been longest with us are the Republican elephant and the Democratic donkey; two others that seem not to have been so well adapted to our climate are the Independent Bull Moose and the Prohibition Camel.

The educational field has its examples. We sometimes say that our instruction runs off the minds of students like water off a duck's back; that when the cat is away the mice will play; that it is hard to teach an old dog new tricks, and that you may lead a horse to water but you cannot make him drink. Some "eductionalists" who feel that they must keep up with the latest pedagogic styles seem prone to run and howl with the pack. Men who study animals only in the laboratory and who know nothing out of doors I have heard called stall-fed zoologists. Huxley called himself "Darwin's bulldog" when, in the great evolution controversy, he was doing the fighting for which the gentle naturalist who had written the *Origin of Species* had no taste. John Burroughs said of one of his early papers that the manuscript came back to him from the editor with its tail between its legs. A certain professor who very much desired a goodly appropriation for his work said he did not think it wise to push hard for it until the president of the university began to cluck. Anyone who has set hens will understand.

All such figures depend for their effectiveness on knowledge of the ways of the animals on which they are based. The significance of "letting the cat out of the bag" can only be fully appreciated by one who has put a cat back into a bag again. Times change and language changes. When everyone drove horses one might say of an unruly youth that he kicked over the traces; when electric trams came in one might say he slipped his trolley; when the automobile followed, then one might say he stalled his engine; when the airplanes came, one might say he went into a tailspin. As our ways of living in the Machine Age remove us from contact with animals, some of these figures become obsolete. New figures appear.

There is no end to the illustrations that might be cited to show the prevalence of ideas derived from association with animals embodied in the language of today. It is sufficient to have reminded ourselves that the effectiveness of such language springs from likenesses in our nature to that of animals. Here is the "touch of nature that makes the whole world kin."

[5] Matthew, 7:6.

OUR MOST BEAUTIFUL LAND SHELL

It spends nearly all of its life in the air, is bisexual, and hatches babies that are almost perfect replicas of the parent, even to the exquisite shells, which in the adult are pearls of great price to an ever-increasing number of collectors

By HARRIET GRAY BLACKWELL

RED COATS are not for *Liguus* hunters, and neither hounds nor bugles blaze a joyous path of sound before them, but in spite of this lack of stage properties, theirs is a fascinating sport. The ardor of those in south Florida who collect tree snails of the genus *Liguus* [pronounced lig′-u-us] makes that of, say, an antique collector look pale. In fact one man frankly admits that there are two forms of insanity known in this section: one which is sent to Chattahoochee for confinement and the other, with dilated eyes and quickened breath, wanders at large on the trail of the tropical *Liguus*. A small boy whose parents make frequent jaunts into the wilds in search of *Liguus* recently remarked to a neighbor, "They've gone again. They've been shell-shocked ever since I can remember."

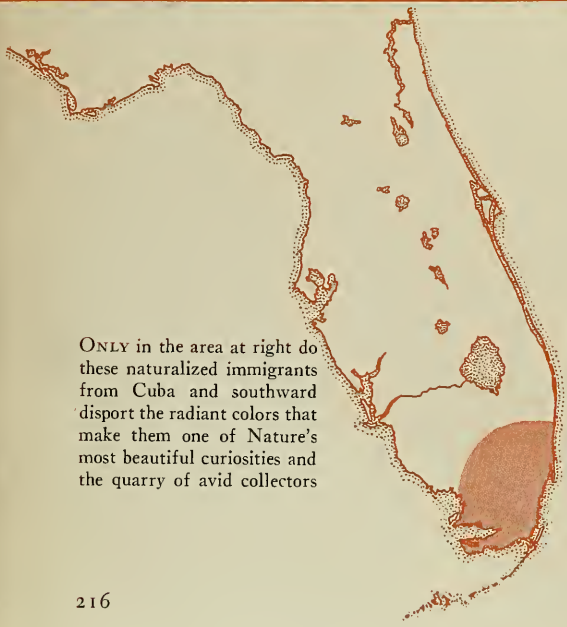
What is this indefinable force that makes men and women face positive danger just for the thrill of picking from its native habitat one of the beautifully formed and colored shells that houses the *Liguus,* or tree snail, of southern Florida?

Perhaps this element of danger is partially responsible for the lure of *Liguus* hunting. Tropical heat is the worst factor. Add to this poison ivy, cactus spines, thorn bushes, mosquitoes, water moccasins and an occasional rattlesnake. At certain seasons during flood stages in the Everglades, collectors wade in water to their armpits across submerged tropical savannas to the higher land of a hammock. The greatest potential danger is hidden potholes. These are natural formations in coral rock, and when covered with grass leaves and branches, are similar to pits used for trapping tigers in Africa. Some are a foot across, some two or three feet, and they are from two to fifteen feet deep.

Not long ago when a party was out hunting, a particularly talkative man broke off in the middle of a sentence. His companions looked around but he had disappeared. Finally one of them saw the tip-end of his long, jointed snail pole feebly waving. He had fallen into a pothole twelve feet deep!

"It is unwise for hunters to go out alone," says a scientist who frequently guides groups through the marshes and hammocks. "Last winter an elderly physician was pursuing his passion for snails when he strayed too far from his companions. He was lost for three days and nights and almost died from exposure. Collectors should not leave their cars even for a distance of two hundred yards without taking a canteen of water, and the more prudent fortify them-

Miami Daily News Photo



ONLY in the area at right do these naturalized immigrants from Cuba and southward disport the radiant colors that make them one of Nature's most beautiful curiosities and the quarry of avid collectors

selves further with sandwiches. They generally hunt in pairs and it is never desirable to have more than six in a party."

The equipment of each hunter consists of a long pole with a net to take snails from the trees, a sack for the shells and a machete to cut through the jungle. Of course, hip boots and snake venom antitoxin are necessities.

The genus *Liguus,* consisting of six species and many subspecies, is indigenous to the northern and northwestern parts of South America, Cuba, Haiti, and the east coast of Yucatan, as well as tropical Florida. There are many speculations as to how these snails came to Florida. We may assume Cuba as the point of origin in considering the three most plausible explanations. Perhaps at a time in the distant geological past there was an emergence of the land which made possible an overland migration of the snails. Or they may have been brought during hurricanes when trees, to which the *Liguus* were attached, were uprooted and swept by the Gulf Stream to Florida and the outlying Keys. Snails may have survived such a tempestuous voyage to crawl from their sea-jour-

(Left) ARMED with long poles and snake bite antitoxin, these intrepid snail hunters start off in search of some of the 50 subspecies into which scientists have classified the astonishingly diversified types of the *Liguus*. So great is the collecting lure that the hobbyist braves tropical heat, floods, and worst of all, brush-hidden potholes, two to fifteen feet deep, which make it unsafe for the enthusiast to travel alone

LONG POLES pluck the *Liguus* from its treetop perch, as shown at right, and quickly bring it to the collector's bag. Late summer and early fall are open season on *Liguus*, but unrestrained hunting may hasten the demise of an already doomed creature

Miami Daily News Photos

neying branch to a congenial tree and begin a new life in this country. Although during a hurricane an uprooted tree might travel from Cuba to the Florida Keys in 48 hours, some authorities do not think it probable that the shells could survive such buffeting in a stormy sea.

The third explanation as to how the snails came to Florida is more colorful and romantic. It is known that the Carib Indians, those native inhabitants encountered by Columbus, came from Cuba and the West Indies and settled Florida. They rowed over in giant canoes about 80 feet long, and it is not too fantastic to believe that they were accompanied by medicine men who brought healing herbs and plants with them. Possibly snails were attached to some of these plants and made their entry this way. They also could have been introduced by religious leaders who might have used the bright-colored shells in their ritual. In any case, it is believed that it took thousands of years for *Liguus* to become established in south Florida.

The *Liguus*, a gastropod mollusk, has a mouth at the anterior end of its body, furnished with a moving lingual ribbon covered with rows of thousands of tiny teeth, which rasp off its food and reduce it to small particles. It is strictly arboreal and exists on confer-

(Below) ANCHORED to its home tree by a gummy exudation, the snail will not move in dry weather. Rains during the egg-laying season in spring sometimes send it adventuring overland at the rate of 25 feet a day

void or fungus growth on the bark of trees. It is bisexual, and late in August or September crawls down from its tree home, burrows into the leaf mold until only the tip of the shell is visible, and deposits from eight to fourteen eggs in a single pile. It does not lay eggs until it is three years old, and then it dies, sometimes on the nest, sometimes 30 days later.

These eggs, solid brown in color and slightly kidney-shaped, are about the size of a black-eyed pea and stay in the ground for six months. Then the warm rains of March and April cause them to hatch. Newly hatched *Liguus* are perfect replicas in miniature of adults, even possesssing a tiny shell. As the young mollusk crawls over the bark and leaves of trees absorbing food, its shell is constantly enlarged by secretion of lime and horny substance by its mantle, a membrane that surrounds the forward part of its body.

Do not think that specialized education is essential for becoming an avid shell hunter. It is true that the scientist Pilsbry describes a tortoise-shell *Liguus* in this manner: "The ground color is usually yellow but varies to almost white. The pattern consists fundamentally of broad, sinuous dark flames which fork below the white sutural line, producing a tessellated border, often smeared with reddish. The flames terminate in a dark band at the periphery, which is bordered below by a light girdle. The base is radially streaked. Over all of this there are the usual green or olive spiral lines, when these are not lost in general melanism." But equally enthusiastic is the man who has no idea of the meaning of such scientific jargon when he says, "Wow! Look at this one!"

It is amazing that such similar things can have such countless variations. Some shells are pure white, others chestnut or tortoise-shell banded in white, white and green, yellow, pink and green, rose and gray, and orange. Some are splotched, others solid and banded in contrasting shades.

There are about 50 subspecies among the *Liguus,* but a general classification divides them into three

(Below) THE DAY'S HAUL shows the endless variety of these exquisite shell designs. Some specimens, of which only a few exist throughout the world because the variety is extinct, are worth hundreds of dollars

THE COVETED *shells range from pure white through all colors of the rainbow. Man's greed, floods, draining operations, forest fires, and other factors are slowly obliterating our most beautiful land shell*

Miami Daily News Photos

groups: pink-tipped, white-tipped and *solidus*, which can have either a pink or white tip. Some specimens, such as *Liguus solidus pictus*, are worth hundreds of dollars because the variety is now extinct. Only a few of these exist, two in private collections, one in a London museum, and possibly two others in American national museums. Mature shells are measured in millimeters, the largest reaching 70 millimeters, or about 2¾ inches, while the average collector's shell is 50 millimeters.

The best time to collect shells is in August, September and October, for they are then through their summer growth and the new growth is brilliant and porcelain-like. They do not grow in winter, but begin to add to their shells in April, the time when baby snails are hatched. The shell grows for five months of the year. As it forms, it is fragile; then it hardens, and hibernation takes place. Each new section of shell marks a year in the life of a *Liguus*.

During dry seasons snails exude a gummy substance called "epiphragm," which attaches them in a dormant state to the trees on which they live. In April, when the rains begin, this substance is dissolved and they become active. If there is an unseasonable dry spell, they again become dormant, moving around only in wet weather.

Sometimes instead of laying their eggs directly under their home tree as is customary, the spirit of adventure enters a group, arousing in them a desire to form a new colony by moving to a different spot in the hammock or to an adjacent woodland. They journey haphazardly through the rain, covering about 25 feet a day. Crows and other large birds have been known to prey on them, and are occasionally responsible for establishing new colonies by carrying snails from one spot to another.

The area in which the *Liguus* is found is limited, a strip perhaps 100 miles long and 50 miles wide, from Pompano to Cape Sable, and from Miami west through the Everglades to the Pine Crest district. This is exclusive of the Florida Keys, many of which harbor tree snails.

Liguus are found only in hammocks, which are forest oases in the Florida sand. These dense, wooded spaces contain hardwood trees of West Indian origin: the gumbo limbo, Jamaica dogwood, mahogany, live oak, ironwood, mastic plum and wild lime. Snails refuse to live in muddy mangrove swamps but thrive in the cool and moist hammocks.

Sometimes hammocks are named for people who discover them or because of something incidental to their discovery. Once a man was searching in an airplane for an abandoned tractor, called a "glade buggy." He discovered a new hammock hidden in the heart of a cypress swamp and when he reported his find to an authority on *Liguus*, he said it would take a bloodhound to locate it. Since then it has been known as Bloodhound Hammock.

Not all of them are so quaintly named, for in 1928 Harvard University sent a party into the Pine Crest area to make a general survey of the hammocks, and these were not named but numbered from one to 28. Since then over 100 other hammocks have been discovered in the same region. Altogether there are approximately 400 hammocks, exclusive of the Keys, in which *Liguus* may be found.

Aside from the thrill of finding shells, *Liguus* hunters see many interesting things along the way—lacy ferns and exotic air plants, orchids clinging in unbelievable loveliness to ancient live oaks, sea birds that fish the canal along the Tamiami Trail, the snowy egret in its bridal plumage, groups of Seminoles in clothes that might have been patterned from the coloring of the *Liguus*, and tawny streamers of death that rustle sinuously through the saw grass of the Everglades.

Before long these beautiful tree snails will be extinct, for the sea is slowly but surely devouring the Keys with their hospitable hammocks and their intriguing names. Man, too, is sometimes unscrupulous in his collecting, taking immature shells before they have had time to fulfill their destiny of reproduction. Collectors should remember that Nature's riches are not inexhaustible. Even more serious than greedy shell hunters is the threat of extinction caused by flooding and draining operations to which the land is subjected without thought of the life that would be destroyed. Tropical storms and birds also have a part in this destruction, and these, added to the holocaust of fire that sweeps over the Everglades each year, will eventually wipe the exquisite *Liguus* from the face of the earth.

Further information on the tropical Liguus *may be found in:*

Charles Torrey Simpson, "The Florida Tree Snails of the Genus *Liguus*," *Proceedings of the United States National Museum* (Washington, 1929), Vol. 73, Article 20.

Henry A. Pilsbry, "A Study of the Variation and Zoogeography of *Liguus* in Florida," *Journal of the Academy of Natural Sciences* (2nd series: Philadelphia, 1912), Vol. XV.

George W. Tryon, Jr., and Henry A. Pilsbry, *Manual of Conchology* (Philadelphia: Academy of Natural Sciences, 1899), XII, 160-186, Plates 55-60.

THE FIRST WATER of Cataract Creek issues from beneath an enormous mass of sedimentary rock in a stream about the size of a man's wrist and is quickly augmented by other springs and rivulets. Thus the stream is born which fertilizes the lush oasis of the Havasupai in a world of barren crags and gorges. The natives, who have probably never numbered more than a few hundred, call themselves the "Blue-green Water People"; and the beautiful river to which they owe their life has created in its spectacular setting the atmosphere which Charles Wakefield Cadman has immortalized in his song, "The Land of the Sky-blue Water." Dense growths of willows and cottonwoods line its banks, among which hummingbirds and other flitting wings give life and color to this second Garden of Eden

The home of the BLUE-GREEN WATER

Towering cliffs that can be scaled in only a few places surround the tiny irrigated fields of an entire tribe of Indians in northern Arizona, whose small realm boasts three waterfalls higher than Niagara

APPROACHED from the south rim of the Grand Canyon by a tortuous twelve-mile trail (about 30 miles from El Tovar) which zigzags down narrow ledges and around dizzy promontories, the picturesque canyon of Cataract Creek is unique as the isolated homeland of a tribe of Indians rarely visited by travelers and sheltered from many civilized influences. Near its northern end the canyon, like the Grand Canyon into which it empties, is a double gorge: first a mile-wide canyon that is 2500 feet deep, then a narrow gorge 300 to 500 feet deep. In the bottom of this live the Havasupai Indians, whose tillable land, hemmed in between cliffs and slopes of fallen rock, amounts to only 100 acres. Their village is located about six miles from the mouth of Cataract Canyon, where passage is rendered almost impossible by a series of falls

WITH THE ADVANCE OF SPRING the Havasupai abandon their hunting of antelope, mountain sheep, and deer on the higher land and begin another season's planting. Corn, squash, melons, figs and peaches are the chief crops. Early in the season the people formerly took refuge from the cold in caves in the cliffs. But in summer they work in early morning to avoid the heat of midday sun.

The Indians have developed an effective system of irrigation and are proud of their large harvests. Water is led to the fields from the rapid stream by ditches. The plots are fenced as seen in this photograph. Trouble, however, is always able to come to this narrowly confined paradise, for sudden floods sometimes swell the stream to enormous proportions and carry down horses, houses, trees, crops, and even soil. At such times the "Blue-green Water People" scurry to higher ledges for their lives

HEAD CHIEF MANAKAJA: a venerable Indian who is now totally blind. Though the tribe is small and untroubled by external problems, several chiefs are traditionally permitted to exercise their judgment in tribal affairs

PEOPLE

By JOSEF MUENCH

"PACKAGE OF COFFEE," or more properly Pakatako-ba, who shows in his strong profile the rugged complacency that is typical of this peaceable, isolated tribe. An avid interest in the world beyond their narrow, rock-girt domain, however, enlivens their mental outlook

For further information concerning the Havasupai Indians, see Leslie Spier's "The Havasupai of Cataract Cañon," *The American Museum Journal,* December, 1918, pp. 637-645; and "Havasupai Ethnology," *Anthropological Papers of the American Museum of Natural History,* 1928, XXIX, Part III.

SUN-BATHING is sometimes indulged in by these Indians, especially while awaiting their turn in the sweat bath. This is a small beehive-shaped hut accommodating four persons, where water is sprinkled on hot stones and the temperature rises to 145°. A cold plunge in the stream often follows this steam bath

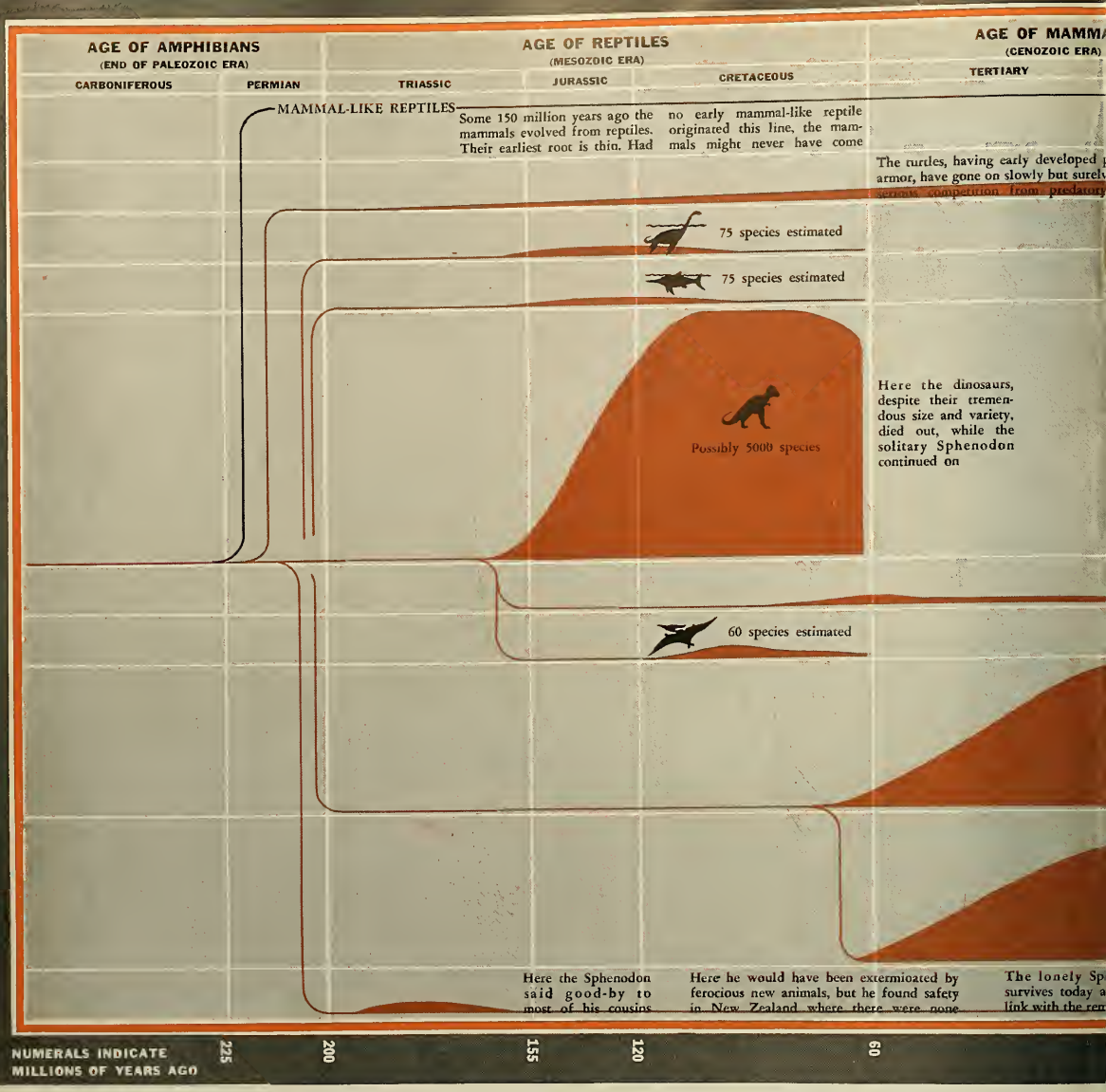
(Right) THE CHILDREN are sturdy and learn to swim and ride horseback by the time they are about four years old. Here two of them are seen at some ruins of old dwellings, recently discovered in the canyon

(Left) NAVAHO FALLS is estimated to be higher than Niagara and carries a considerable volume of water even when the river is at a moderate level

(Right) Reputation for being the most beautiful falls in Cataract Canyon is held by Havasu Falls. It is estimated to be over 200 feet high and is sometimes called "Bridal Veil." A box canyon is seen in the background with towering cliffs rising abruptly

(Below) Only a few miners and, lately, enthusiastic tourists have pressed through virgin land three miles from the Indian settlement to see this beautiful cascade, Mooney Falls. The umbrella-like limestone deposit so conspicuous in this view occasioned a disaster which gave the falls its name. Long before the Indians were under the protection of the government a prospecting party of which a miner named Mooney was a member reached the edge of the cataract and wanted to get to the lower section of the canyon. Mooney was let down over the edge on a rope. It was too short to permit him to reach the bottom, and when the party above tried to pull him back, the jagged edge of the rock held him down. He died there on the rope. Later, miners built two vertical shafts which go right into the rocks, but these come out still high above the floor of the canyon. Now the traveler can descend to the mist-bathed edge of the pool on steep, slippery steps made practicable only by the use of large spikes driven into the rocks for handholds

(Below) Every bend in the river opens up new beauties in this secluded canyon. Here, below the settlement, the river becomes shallow and quiet beneath the Red Wall formation before projecting itself far out into the dun-colored Colorado River, two miles below this point

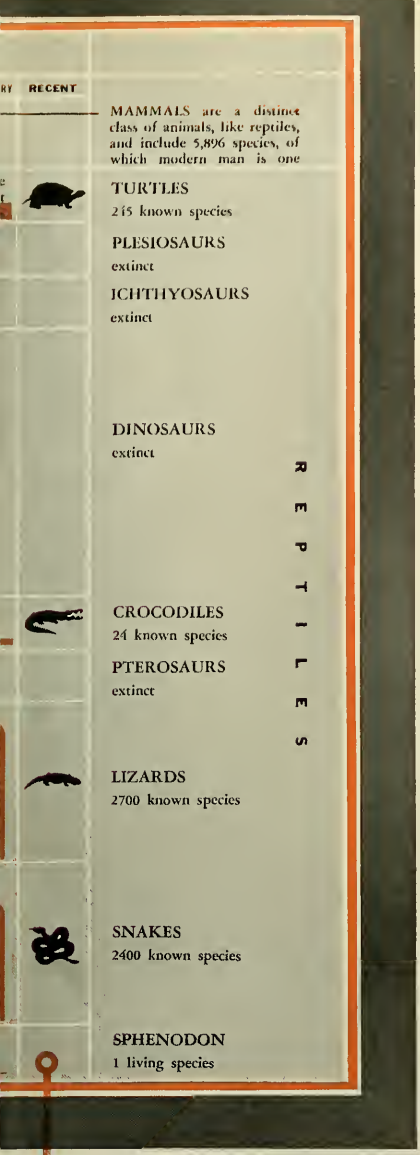


An American Museum expedition visits the home of the anachronistic Sphenodon, the solitary monarch of an empty dynasty, who now boards and lodges with a bird

NOVEMBER 3, 1769— ". . . At breakfast a cluster of islands and rocks was in sight, which made an uncommon appearance from the number of perpendicular rocks or needles (as the seamen call them) which were in sight at once. These we called the Court of Aldermen, in respect to that worthy body, and entertained ourselves some time with giving names to each of them from their resemblance, thick and squab or lank and tall, to some one or other of those respectable citizens."

Thus did Sir Joseph Banks, naturalist of Captain Cook's first voyage of discovery, describe the passing islands which today are one of the last homes of the tuatara, *Sphenodon punctatus* [pronounced Sfee'-nodon punk-tah'-tus], the sole survivor of one of the most ancient and primitive orders of reptiles—truly a link with the Mesozoic era of 60 million years and more ago. Had Sir Joseph known what a zoological prize was to be found in this little circle of islands it is certain that he would not have discussed their contours so flippantly.

The *Endeavour* with Captain Cook and his crew



BY BOAT TO THE AGE OF REPTILES

By G. Miles Conrad

Assistant Curator, Comparative Anatomy, The American Museum of Natural History

As a tree trunk forks into boughs, branches, twigs and leaves, the family tree of any class of animals is divided into orders, families, genera, and species, to show the degree of relationship between its many members. The class known as reptiles is divided into five living orders, containing about 5,370 species. The extraordinary thing is that one of these five major orders contains only one living creature, the *Sphenodon (below)*. This means that this animal is less closely related to any other living animal than man is to the numerous animals belonging to his order (Primates), including apes, monkeys, and lemurs. Whereas the dinosaurs were an order of reptiles that died out completely, the *Sphenodon* represents an even older order of reptiles that died out with the exception of one species • • •

(Right) The pencil points to the third eye of his ancient eminence the *Sphenodon*

Courtesy A. N. Brecken

had spent the night of November 2nd under the sheltering lee of Mayor Island and had sailed early the next morning in order to breakfast in sight of the Aldermen some 20 miles distant. Like Cook the members of the Michael Lerner New Zealand-Australia Expedition sought out Mayor Island as a sheltering haven for their marlin studies in New Zealand's Bay of Plenty and, like Cook, several of us set out before breakfast one February morning for the Court of Aldermen.

Link with our reptilian past

Upon arriving in New Zealand the expedition secured permission from the government to visit any of the islands which had been set aside as reservations for the tuatara. All of us had looked forward to a break in our work so we might make a quick trip to one of the tuatara islands, but only a few of us were privileged to make the trip. James Shackelford saw in the tuatara a photographic scoop. To Bernard Sladden, New Zealand naturalist, it was a chance to see once more the islands whose ecology had so intrigued him twelve years before when he had surveyed their fauna and flora. In my mind's eye I saw the shelf in our Museum's Comparative Anatomy Department on which reposed our much prized and studied skeleton of *Sphenodon*. How I and many generations of students had puzzled over the anatomy of this rhynchocephalian [pronounced ring′-ko-se-fay′-lian; literally "snout-headed"] link with our reptilian past! At last I was to see him in the flesh—alive!

After several days of very stormy weather the sky cleared one dawn to find us ready and waiting to make an early start for the Aldermen Islands. We set out in two thirty-foot launches, and after a sail of about two and a half hours, were in the encircling midst of a number of rocky islets rising sheer from the ocean and with not a landing place in sight. Conflicting currents and rips together with numerous submerged rocks and pinnacles made the going treacherous, but fortunately our two captains knew their way about. After a ship to ship consultation as to which island would prove most productive of tuataras, we headed for the largest of the group, called by the Maoris, "Ruamahua-nui."

Of volcanic origin, the Court of Aldermen is composed of three main islands, Hongiora, Ruamahua-nui, and Ruamahua-iti while in the middle of the triangle formed by these three lies a series of rugged peaks known as the Middle Chain. As seen from the south and west the islands reveal the most rugged aspect of their sheer cliffs, pierced time and again by wave-worn caves and bridges. The northerly slopes are less steep and are well covered with brush and low-growing trees. So forbidding are these islands that the Maoris, who prized highly an offshore citadel, were apparently never able to settle and support themselves here as on Mayor and other nearby islands. So majestic was the isolation of the place that when we dropped anchor some 50 yards off Ruamahua-nui, the sound of our voices seemed to strike a discordant note and we involuntarily hushed. The very stillness of the scene served to intensify our smallness among these steep and sheer islets as our boat bobbed gently on an ever-present ground swell.

Our skippers, Sladden and "Curley," surveyed the nearby shore for a likely place to land, and in fifteen minutes we had put our dinghies overboard and effected a landing by holding offshore a few feet and wading in with our gear. After our cameras were ashore we lifted the dinghies up onto the dry rocks so they would not pound out their bottoms. "Curley" had brought along some gloves which offered reasonable safety from bites in removing the tuatara from its burrow.

The shore on which our party landed was a fairly steep and rocky one. Above the high-water line, however, a generous layer of earth provided a firm foothold for a dense covering of low scrub. It was into this maze of *pohutukawa* and New Zealand flax that we next penetrated in search of the tuatara's burrows. The *pohutukawa,* or Christmas tree (named in allusion to its bright red blossoms which burst forth in the Christmas season), grows frequently on cliffs, many of its vine-like branches creeping along on top of the soil, while others grow higher on the trunk and travel for some distance at a good tripping height. The many branches with their leaves form a massive canopy through which little direct sunlight penetrates.

It is in these cool arbors that the tuatara and his roommate, the petrel, are to be found. Movement forward is rather hazardous with the maze of root systems, the lowness of the over-arching branches, and the occasional burrows into which one stumbles. We saw no tuataras in evidence, but off to one side "Curley" yelled that he had one. Then Sladden reported his find. In a mere ten minutes or so we had five or six tuataras of varied sizes and hues, ranging from a greenish-yellow to stone-gray.

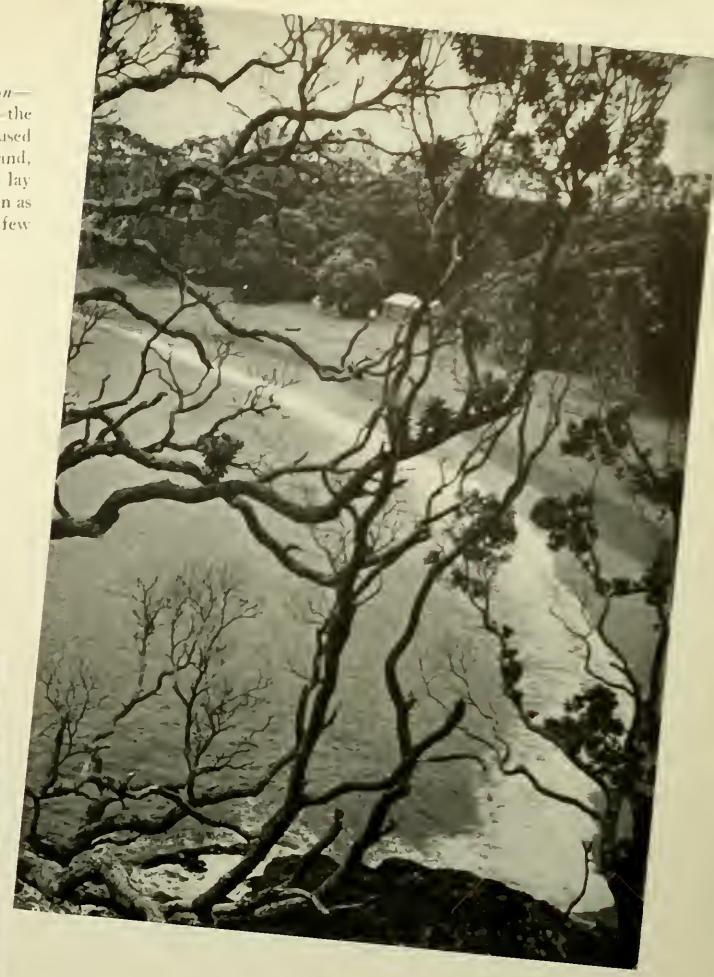
The tuatara grows to be about two feet long and in general appearance it resembles a stoutly built true lizard. Along its back, from head to tail, is a series of spines covered with a thin sheath of horn. The belly is covered by numerous scales, while the rest of the body is granular to the touch. It has large, dark brown eyes with a vertical pupil. While the tuatara is certainly lizard-like in appearance, it differs considerably in many ways. Indeed it belongs to an entirely different order of reptiles, which is almost as remote from the lizards as it is from the dinosaurs. The tuatara's great interest lies in the fact that it is one of the oldest reptilian types which preserves the generalized skeleton that was characteristic of the stem-reptiles of the Mesozoic era. In the hand, for example, are all of the bony elements of the primitive reptilian hand. This pattern with but slight modifications has given rise to the hands of all later reptiles, the mammals and, finally, to man himself.

A third eye

The third, or "pineal" eye, so characteristic of the ancestral tetrapods, is well developed in the tuatara. A ring of small scales surrounding a transparent central one on the top of the head marks the position of the pineal eye. Underneath this transparent scale is a much reduced but apparently perfect little eye with a lens and a pigmented retina. The possession of this third eye in the tuatara is not unique among living reptiles, for a number of true lizards possess them also. In the lizards, however, the nerve leading from this eye to the brain is degenerate, while in the tuatara

WHILE hunting and studying the *Sphenodon*—lone survivor of an ancient reptilian lineage—the members of the Michael Lerner Expedition used the cove at right on Mayor Island, New Zealand, for their base camp. Twenty miles to the north lay the group of declivitous volcanic islands known as the Court of Aldermen, which is one of the few remaining homes of this living fossil

Photographs by the author



INSIDE a triangle of three larger islands, the party landed on one of a series of rugged pinnacles called the Middle Chain. Below, James Shackelford, photographer, and Captain "Curley" are examining one of the numerous wave-worn bridges and caves

(Below) ON THE PRECIPITOUS SHORE of one of the three larger islands, Ruamahua-nui, a difficult landing was made and the search for *Sphenodon* was pursued through a tangled maze of vegetation. The animal lives in burrows, beneath the cool arbors of low arching branches, with the petrel as his roommate

Photo by James Shackelford, Michael Lerner Expedition, 1939

A TEN MINUTES' search brought the discovery of five or six *Sphenodons,* or tuataras, ranging from greenish-yellow to stone-gray, and up to about two feet in length. This is one of the oldest and most primitive living reptiles and links the present with the remote geologic past

(Left) SIGNIFICANT of *Sphenodon's* survival is his isolation. Even the natives of New Zealand, who prized an offshore citadel, never chose to occupy the forbidding shores of the Aldermen Islands

Photographs by the author

FROM head to tail along the back runs a series of spines covered with a thin sheath of horn. The skeleton resembles closely that of the earliest reptiles

GLOVES were worn as protection against bites when removing animals from their burrows. Though capable of short, swift dashes, they are sluggish by nature

THE SOLITARY SPHENODON has taken up housekeeping with the New Zealand muttonbird, or petrel, with whom he maintains an amicable relationship as shown in the photograph at right. The bird and the reptile have their nests separately, one on each side of the entrance. The *Sphenodon* is fond of lying full length in water. Some think this habit indicates that in ages past he swam from troubled Asia to peaceful New Zealand at a time when intervening seas covered much less than the present 1000-mile stretch

Photographs courtesy of A. N. Brecken

FINDING security many millions of years ago in New Zealand, the *Sphenodon* lived an idyllic existence up to the coming of white man. Then the introduction of pigs almost brought him extinction, and he was left in peace only on the islets along the coast.

Rigid protective laws have fortunately checked the demise of this interesting creature out of the past, who apparently wants to do nothing more than to remain a peaceful and sluggish bystander through perhaps another 100 million years of the world's evolution

it is well developed. The manner in which this pineal eye now functions—if indeed it does—is not known.

Although they are capable of digging with their forelegs, like a dog, the tuataras seem to prefer to move into petrel-dug burrows. They apparently live at peace with their feathered cellmates, an arrangement which seems to offer an advantage only to the tuatara, who is spared the labor of building its nest and who is occasionally treated to the remnants of the petrel's fishy meals. Other than this housekeeping function the tuatara apparently offers nothing to the commune.

In writing of the holes excavated by the tuatara itself, Andreas Reischek, an early New Zealand naturalist, describes the burrows as from two to three feet long with a diameter of about five inches. This passageway leads to an enlarged chamber about a foot and a half long by a foot wide by six inches high, which is lined with grass and leaves. The bird and the reptile have their nests separately, one on either side of the entrance. So well established is this symbiotic relationship that it is said the petrel is usually to be found nesting to the left and the tuatara to the right of the entrance!

During the daytime the tuataras stay close by their homes and in our scramble through the scrub we saw none outside of their burrows. At night they emerge in search of food which consists of beetles, grasshoppers, spiders and other small animals. It has been said that they occasionally catch the small lizards which abound in New Zealand. In spite of their generally sluggish behavior they are quite capable of short, swift dashes, so that even such fast moving creatures as insects easily fall prey to them.

Readily enters water

Seemingly as if in dim reflection of its Mesozoic relatives, several of whom were amphibious in habit, the tuatara often enters the water of its own accord and is said to be a good swimmer. It has been suggested that perhaps a portion of its food is gathered in this way. The accounts of captive tuataras are replete with stories of their great partiality for lying full length in a pan of water.

So fond are they of such bathing that Newman tells of one of his which even laid two eggs in water! Normally, however, they lay from eight to ten eggs in holes in the sand. These eggs are about two-thirds of an inch in length, covered with a thick limy material.

Which came first: the tuatara or the egg? To this paraphrase of a perennial question the Maoris had an answer. According to Elsdon Best, their very elaborate mythology relates that Tane, the power who had brought light to the world, ". . . sought out certain female beings by whom he strove to become the progenitor of man. It was found that reptiles produced eggs, which was considered to be an unsuitable mode of reproduction for them; hence it was decided that reptiles should be viviparous [which is indeed the case with the live-bearing New Zealand gecko, *Naultinus elegans*], and that the production of eggs should be confined to birds. An exception was made in the case of the tuatara *(Sphenodon punctatus)*. The first egg was formed by Peketua, who took it to Tane and asked him what he should do with it. Tane replied, 'Give it life,' and that egg produced the reptile called tuatara, which is thus allied to the birds."

It seems doubtful, however, that the Maoris ever developed an inclusive term for the reptiles as opposed to the birds, insects and other animals common in New Zealand. *Ngarara* is often translated as reptile or monster, but just as often means insect, especially one regarded as the cause of pain. The Maoris, in common with other Polynesian folk, believed lizards to be the bodily form of those mysterious demons that attacked man from within, causing disease and death. It seems, then, that in this case reptiles and insects were classed together as pain producers. Another word, *moko,* may be translated as lizard *(moko papa,* lizard of the trees; *moko parae,* lizard of the open country); as caterpillar *(moko tawhana);* or, most frequently, as the tattooing of the face or body. Here the common attribute is one of coloration and markings, that is, many of the lizards and caterpillars might be regarded by the Maoris as "the tattooed ones."

How it got its name

Sphenodon was known variously as *ruatara, tuatete,* and *tuatara.* All of these words may be translated as "spiny" and, by extension, *Sphenodon* becomes "the one with spines and wedge-shaped teeth." According to Dieffenbach, who explored New Zealand in the 1830's, the natives occasionally referred to the tuatara with the general name *ngarara.* Thus, while the Maoris apparently recognized the similarities of *moko* and *tuatara,* they probably never went so far as to include the numerous sea turtles with other reptiles. As in Ireland, snakes are not present in New Zealand and were no problem to the Maori philologist. Whether or not the Maori recognized the reptiles as a natural group, it is certain that he regarded all lizard-like creatures as demons to be shunned.

New Zealand's sovereignty was still a matter of warlike dispute between the Maoris and the English settlers when, in 1831, knowledge of the tuatara was first presented to the scientific world by John Edward

Gray in a paper entitled, "Note on a Peculiar Structure in the Head of an Agama." It was in this note that the tuatara was first labeled *Sphenodon*, the name best known to zoology students. For a number of years the full significance of this newly discovered reptile remained even more obscure to zoologists than it had been to the Maoris. Finally in 1867, Günther's "Contribution to the Anatomy of *Hatteria (Rynchocephalus* Owen)" made clear to the world the uniqueness of the species, which he proposed should be the type of a distinct order of reptiles, equal in rank to the turtles or the crocodilians and entirely separate from the lizards.

Numerous fossil rhynchocephalians were soon found and eventually a partial family history of tuatara was pieced together.

Tuatara's story

About 200 million years ago, early in the Age of Reptiles, a tuatara-like form was developed from the line which later was to give rise to the dinosaurs and the crocodiles. During this Triassic age, which lasted about 45 million years, the sphenodonts enjoyed a mild success in the world and reached their maximum specialization, at the same time spreading throughout Europe and south to southern Africa. The following age—the Jurassic— found members of the family migrating to the New World and settling in Wyoming. Among these Jurassic sphenodonts was one, *Homoeosaurus* of Bavaria and England, which is almost identical with our modern tuatara.

Even before the end of the Age of Reptiles and throughout the succeeding Age of Mammals the tuatara's family is lost from sight. But while the record is blank during this period we can be sure that tuatara and his reptilian cohorts were hard pressed by the new and more efficient mammalian machines which had come into style. Gradually they were pushed out into the southern continents, many forms dying out, but always the tuatara was a jump ahead of its enemies. At last the sphenodonts crawled—and perhaps swam a little—down through Malaya, across New Guinea and into New Zealand. They were just in time! As the Cretaceous period (and with it, the Age of Reptiles) was drawing to a close, the land bridge sank which had led from the North Cape of New Zealand through New Caledonia to New Guinea. Thus the tuatara gained a citadel which was separated by more than 1,000 miles from his nearest potential enemies. In a later day, the relatively weak marsupials were to find refuge from the placental mammals in much the same way on the neighboring continent of Australia.

The dinosaurs had risen to power and had fallen; the mammals had flowered out in bewildering array, and man had come to overlord the world, while tuatara, phlegmatic survivor of an ancient world, had found his niche in the burrows of the New Zealand muttonbird.

Until Captain Cook's day the tuatara must have led an idyllic existence. There he was in a land of plenty with food in abundance and isolated by many miles of water from his mammalian enemies. Even man was at first wary of calling down demoniac wrath by molesting him. When the white man came, however, pigs were released to multiply and serve as a source of provender for future mariners. Once more the tuatara was nearly exterminated on the mainland and left in peace only on the small islets along the coast.

Thus, history repeats itself, albeit on a smaller scale: once driven from the continents to the remote continental islands of New Zealand, the tuatara was now driven out to the very fringe of the world itself.

Strictly protected

If the early white men were responsible for tuatara's near extinction (though it is true they were ignorant of his existence) modern New Zealanders are more than making amends. In the Bay of Plenty there are no less than five tuatara reservations: Karewa, Aldermen, Mercury, Poor Knights, and the Big Chicken islands, on which it is forbidden even to land. Throughout the Dominion it is *absolutely* forbidden to kill or harbor a tuatara. So inviolate is this law that our expedition, although permitted to land on any of the reservation islands, was expressly prohibited from taking any specimens.

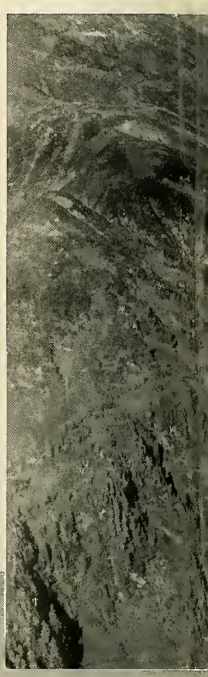
This policy of a perpetual closed season on tuataras seems to be proving effective for, according to several New Zealand zoologists, the population is definitely on the upgrade. Occasionally specimens are reported from the more inaccessible parts of the mainland which seems to be an indication that the family Sphenodontidae is once more rising above adversity. Indeed it would seem that this process could be accelerated if the government would plant a few tuataras on other lonely islets where the muttonbirds live in their burrows. Assuredly the scientific value of even a preserved tuatara is sufficiently great to warrant a carefully devised plan to let them breed under natural conditions.

The encircling gloom of late afternoon was falling rapidly on The Court of Aldermen when at last we set a course for Mayor Island. As we looked back on the bleak, wind and wave swept islets falling behind in our wake, it seemed as if we were leaving a lost world—a world entirely unsuited to man and dominated by reptiles.

HOW TOTEMLAND

(Left) BEFORE *the Ice Age the coast of southeastern Alaska probably lay at approximately the outer edge of the Alexander Archipelago. Glaciers sculptured the bedrocks into innumerable islands and channels which even on a simple map tell the observing eye that this land was carved by ice. The numerals indicate the position of 1—Muir Glacier, 2—Rendu Glacier, 3—Brady Glacier, 4—Dundas Bay, 5—Geikie Inlet*

(Below) THE SCENIC SPLENDORS *of the celebrated "inside passage" to Alaska reveal a dramatic chapter in the story of Ice, the great earth-sculptor. The myriad islands that shield boats along this route were once part of the North American mainland. The great glaciers of the Ice Age carved the intricate channels separating them from the mainland and hewed the coast of southeastern Alaska into one of the most scenic regions of North America*



WAS CARVED

By JOHN C. REED
Geologist, Alaskan Branch
United States Geological Survey

Long before the recording of human history a gigantic sheet of ice descended over southeastern Alaska to carve the story of its passing in heroic characters which command the admiration of all who see and know their meaning

ALL PHOTOGRAPHS COURTESY OF UNITED STATES GEOLOGICAL SURVEY

AS OUR small, northbound steamer plows slowly through the blue waters of Dixon Entrance into Uncle Sam's wonderland of southeastern Alaska, let us contemplate the formation of this strange and little-known part of our still less-known largest territory.

It is a Paul Bunyan sort of place where magnificent, glistening, blue, green, or white glaciers flourish in a moist, temperate climate; where alpine avalanches thunder down through rain forests; where Strawberry Point lies between Glacier Bay on one side and Icy Strait on the other; and where many streams literally stand on end, as shown at left.

And from these natural paradoxes in Alaska have sprung a host of human ones: native-born Americans are taxed but have no vote in national elections or in Congress; milk is delivered to youngsters by air-

(Above) STREAMS *that literally stand on end drop from glistening lakes nesting in ice-gouged basins. The rounded surfaces of the rock and the upland lakes plainly show the rasping action of the great ice mass that once moved over this area near the south end of Baranof Island. Though thousands of years have passed, the time in geological terms has not been great enough for these vertical streams to cut normal valleys for themselves in the hard rock*

(Above) AN ALASKAN "STREETCAR" *carries a passenger to a gold camp: a method of transportation which in this paradoxical land is even used by the milkman. The great ice left a mountainous landscape difficult to traverse by railroad but supplied with abundant water landings for the airplane. The pilots are general errand boys and do everything from matching a spool of thread for an Indian woman to taking a passenger 50 or 100 miles to see* Pinocchio

(Left) STEEP ROCK SLOPES *rise from the sea to rounded tops planed off by the great ice mass. Higher, project peaks which stood above it. Here the granitic bones of Chichagof Island glisten bare in the warmer, postglacial climate against a background of the open Pacific*

(Below) BEETLING CRAGS *give character to a land that has been torn by the elements. Here the sea has added its work to that of the ice, gnawing a mighty cliff. The now-abandoned radio beacon on Soapstone Point, Yakobi Island, perches precariously on a spot where few trees are able to withstand the gale-driven salt spray of the waves*

plane; the grizzled prospector uses a fishing boat instead of burros; and skips in mine shafts are guided by timbers shipped by steamer into this heavily wooded country from faraway Seattle.

It was an icy hand that carved these frowning coasts into myriad waterways, flanked to altitudes of over 1000 feet by beetling crags and dark, timbered slopes. Above the lower slopes, in some places, rise bare, rounded summits, and in others bristling, serrate peaks. Here the frigid touch of the Gargantuan sculptor still lingers, and frosty tremors still thrust rivers of ice into the temperate coastal lands and even into the sea, where they are irresistibly dissipated by the gentle warmth of the ocean water as shown at the bottom of this page.

Before the first lethargic chill of the great Ice Age (the Pleistocene epoch in the time scale of geologists) settled upon what we now call southeastern Alaska, long, long before the first Indians paddled their canoes to the first potlatches—so long ago that the time since the Indians came compared to the time before might be likened to a single grain of sand compared to all the other grains in a child's play bucket—the area must have been roggedly mountainous. Possibly it was more rugged than now, though of this we are not sure; but certainly it was cut across by deep valleys leading down to a coast probably lying about in the position now occupied by the outer coasts of the outer islands of the Alexander Archipelago.

Locally along the outer coast and elsewhere stretched a broad coastal plain that had been slowly planed by the battering attack of the open Pacific as the land, or sea, oscillated through a vertical range

(Right) BRISTLING PEAKS *rise defiant above the waning glacier. The rounded divides in the foreground on both sides of the ice tongue show modeling by an overriding glacial sheet. Still a mighty ice stream, this glacier is but a shriveled remnant of the mass that formerly filled the valley to overflowing. The darker band of material at the lower edges of the glacier is rock debris, gouged out and brought down from farther "upstream." It is concentrated around the lower edge by the melting away of the ice enclosing it. The scene is of Dundas Bay Glacier, part of the recently enlarged Glacier Bay National Monument*

(Left) AT THE SEA *Dawes Glacier ends its losing fight against a milder climate than the one which made southeastern Alaska a land carved by ice. The snout forms an ice cliff nearly three-fourths of a mile wide and about 200 feet high, dwarfing the floating bergs beneath. The dark lines parallel to the direction of flow are surface debris, indicating the convergence of headward branches of the glacier*

(Left) AN ISLAND *of rock in a sea of ice. The rounded* nunatak *in the foreground would probably remain as a peak had not the ice, which once surmounted it, scraped it down. The higher peak behind kept its rugged profile because the ice did not override it. Viewed from above, large inland masses of ice like this, which often discharge seaward through several valleys, give a better idea of what southeastern Alaska was like in the Ice Age than do the tongues of ice seen from the steamer's deck. This is the Cushing Ice Plateau, which feeds ice into Glacier Bay by several arms*

of several hundred feet. From this plain the surface rose abruptly, even precipitously, to the uplands.

Gradually the climate became such that in the higher areas, probably first along the main crest of the Coast Range where now runs the British Columbia-Alaska boundary, snow and ice began to accumulate and ice tongues started to push down the valleys. Many climatic factors affect the formation of glaciers, and it should be perfectly clear that a lower mean temperature is only one. Others include rainfall and its distribution through the seasons, directions of prevailing winds, altitudes of the land masses, and the temperature and distribution of ocean currents.

Slowly, spasmodically, the high snow and ice fields expanded. The glaciers became longer and more powerful. New ice-collecting fields appeared at lower levels to contribute their glistening loads to the main tongues that were now advancing far down the principal valleys, gouging them deeper and shaping them from narrow V's to broad, flaring U-shaped troughs like that shown in the photograph at lower left and lower right. Into the sea thundered giant icebergs as the waves and tides of the restless ocean shook the floating snouts of a thousand mighty glaciers.

But even this was not the end, for southeastern Alaska then was truly in an icy grip. The ice fields coalesced, the valleys became filled with more ice than they could hold and overflowed. Instead of barren ridges separated by glaciers, there appeared a broad ice sheet covering practically all of southeastern Alaska and extending out to sea. Slowly, almost imperceptibly, the ice of this mass moved outward from the principal higher areas toward the south, southwest, and west. In many places the flow probably was concentrated in the now deeply buried valleys, but the higher levels moved also without regard to underlying land.

The altitude of the top of the icecap ranged widely. Along the crest of the Coast Range it lay at a general altitude of about 6000 feet. Southwestward the ice surface was much lower, and along what are now the outer coasts of the islands it reached to about 2500 feet.

Above the monotonous, wind-swept, white expanse of the icecap there projected, here and there, bristling, dark peaks and ridges, too high to be covered by the frigid blanket over which they towered, too steep to retain enough snow and ice for any but local glaciers. The observer can tell, even from the steamer, the height reached by the great Pleistocene ice flood. Below the top of the old icecap the slopes are smoothed and the contours of the mountains rounded. Above the old ice level the slopes are sharp, the peaks are steep, and rock surfaces are not smoothed but are frost-riven, angular, and broken, as shown in the photograph at upper right. Alaskans have attached names to many of the former *nunataks* [rock masses that project above ice just as islands project above water] by which they can be recognized from a map

(Left) THE SNOUT *of Rendu Glacier is black with rock detritus which it has carried down from above. In general this glacier has been receding in recent times, but when visited by the author in 1936 it showed evidence of one of the temporary advances that can occur even in this "nonglacial" age. The sea has driven this glacier ashore except for the small part to the right of the center, which is discharging bergs*

(Right) DEVILS THUMB: *an angular* nunatak, *whose rugged shape tells that it stood above the level of the glacial ice flood. From the steamer one can distinguish these jagged peaks from the rounder rock surfaces below that did not escape icecap glaciation. A long, cloud pennant is frequently seen trailing eastward from this peak, produced when warm, wet winds from the ocean are condensed against its cold sides*

(Below) A POTENTIAL FIORD. *U-shaped valleys are typical of the glacier-carved landscape, for the V-shaped mountain valleys are gouged into this form by the rivers of ice that fill them. Then if the coast sinks the valley fills with water and becomes a fiord. If the sea stood only a few hundred feet higher here near Swanson Harbor, the plain would be flooded and the valley would become a fiord. In the foreground are seen the grounded log frames of a number of salmon traps*

(Left) A BAY OF STAGNANT ICE *flanks the east front of Muir Glacier: an example of how the dying icecap, on a much larger scale, left large remnants in sheltered locations to waste slowly away*

A STRANDED "GLACIERETTE." *This postage stamp sized remnant of rock-laden ice* (center foreground), *all that remains of Wood Glacier, is left to waste away in the long days of Alaska's summer. It dams the fresh water lake in the foreground. The glacier once pushed far down Geikie Inlet to the right to join the main Glacier Bay ice stream*

(Above) IN THE MILDER CLIMATE *following the Ice Age, the sea has pursued the retreating tongues of ice far back between green-clad slopes. Most of the side streams of this beautiful fiord enter through glaciated "hanging valleys," like that at the left containing a sparkling lake*

without even seeing the country—Devils Thumb (see page 237), Kates Needle, and Bear Paw are typical.

Gradually, with many hesitations and false starts, the ice flood began to recede. The effects of changed climatic conditions were, of course, first felt along the lower, outer edges of the icecap. No longer did the shelf ice extend so far out to sea. Slowly ridges near the coast projected farther and farther above the thinning ice cover. Hills formerly buried became *nunataks,* then large rock areas. Eventually the berg-laden sea again beat against rocky headlands separated by valleys still crowded with moving tongues of ice.

Again could have been seen, had anyone been there to see, several widespread ice centers, separated or nearly separated from one another, but concentrated, of course, in the higher parts of the ranges. From these centers alpine glaciers again pushed irresistibly to the sea, thus further sharpening and deepening the river valleys which, as we have seen, existed before the Ice Age first grasped Totemland in its chilly hand. Smaller ice-collecting grounds still lingered near the outer coasts. Here and there large remnants of the old icecap lay in sheltered depressions, slowly wasting away under an ever-increasing load of its own rock debris, or detritus, merely by surface ablation without outward flow. Such a glacier is seen in the center foreground of the photograph at left.

Spasmodically the recession of the ice continued, retreats being followed by advances. But the retreats in aggregate were more pronounced than the advances and, unless we look carefully, the ancient story merges into an impression of a simple retreat. On the whole, the strangle grip of the Ice King was being loosened.

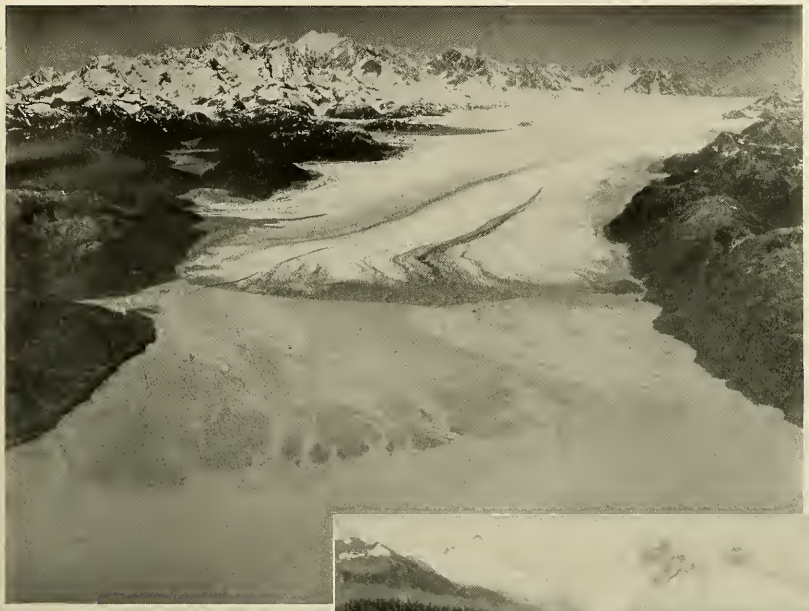
Constantly battering at the floating snouts of the great valley glaciers came the warmer Pacific. And, as the ice reluctantly retreated, so has the sea triumphantly advanced. Far up into a domain formerly not its own the mighty ocean has pursued the gradually yielding ice. Into the old river valleys like that shown above, now gouged far below sea level by both advancing and retreating glaciers, the sea has pursued its adversary until it has relentlessly driven the Ice King ashore, except for a few long-struggling glaciers that have not yet given up and still discharge large bergs into the sea.

And so we have southeastern Alaska—scenic Totemland—where steamers cruise far inland on myriad salty waterways that flood ancient river valleys scoured only recently as the geologist calculates time, by the icy files of great glaciers. And to quicken the imagination of those who for the first time sail

through this mystic land of Indian legend, of magic gold, and of silvery salmon, there remain still the last mighty ice warriors whose titanic struggle goes on unabated in dozens of inlets.

Who knows when the tide of battle may again change, and the ice, perhaps temporarily, again gain the upper hand? For, far up in the Coast Ranges, the remnants of the once blanketing icecap still lie in impressive expanses, and formidable glaciers still push down deep valleys, some to reach the sea.

Thus to one who will but stand on the steamer's deck and see and ponder, the colossal architecture of Totemland takes on new meaning. He sails in flooded river valleys. The precipitous slopes that rise a 1000 or 2000 feet from the water are the ice-scarred walls that once confined a mighty glacier. The rounded, bare, higher surfaces are the result of the irresistible abrasion of an awe-inspiring icecap that once completely filled the huge fiord in which he so unconcernedly sails. And the needle-like shafts and serrate ridges that rise for hundreds or thousands of feet above the high, rounded surfaces become to him gauges that show to what tremendous depths the icy blanket once covered this now temperate land. Toward the east along the crest of the Coast Ranges he sees the remnants of the icecap, and from off the peaks of faraway, frosty *nunataks* he watches defiantly the blowing white cloud banners of the Ice King.



(Above) A THOUSAND *constantly shifting channels carry the melted water of Brady Glacier across a muddy delta to the sea, showing that the sluggish Ice King has lost some of his former power*

(Right) WHEN *will the tide of battle again change? Still lurking on the dazzling upper slopes, the Gargantuan sculptor can again come down to shape the earth—but not in our time*

RAISING BANNERTAILS — *An unrecorded chapter from the home life of one of our most interesting desert creatures*

By VERNON BAILEY
Formerly Chief Field Naturalist, United States Biological Survey

THE BIG four-toed kangaroo rats, well named bannertails because of the white brush on the tip of the very long, slender tails, inhabit the dryest, hottest deserts of the southwestern United States and similar areas of northwestern Mexico.

They are highly specialized for desert life in both structure and habits and have developed with the deserts through long ages of slow change and adaptation. Their long, furry-soled hind feet are highly perfected for speed on sand and bare ground as well as for extensive burrowing. The little front feet, or rather hands, may aid somewhat in digging, but the straight, sharp toenails of the hind feet serve for both pick and shovel. How they can make the dirt fly far out behind!

The long, plumy tail is a wonderful rudder, balancer and brace, and its color and pattern offer protection at night.

The large, apparently black eyes are highly specialized for night work, when the deserts are coolest and most enjoyable. Few animals are more strictly nocturnal, yet they can also see fairly well in the daylight.

Their external ears are short and simple, with folding hoods to keep out dirt; but their internal ears are elaborate sound receivers, surrounded by thin-walled air cells forming the inflated ear chamber, a structure peculiar to underground mammals.

In structure, habits and dispositions, bannertails are fitted for successful, comfortable and enjoyable desert life.

Their food habits have been thoroughly studied and described by Taylor and Vorhies,[1] but their breeding habits are little known.

A pair of fine, large adult bannertails was brought from near Tucson, Arizona, in 1921 and kept for over a year in comfortable cages in Washington, D. C. All summer and winter they were given separate cages with nest boxes, exercise wheels, ample food, and some green vegetation to supply the necessary moisture. They were healthy, sleek and full of energy but would fight savagely whenever they were put in the same cage or turned out together. Often they had to be forcibly separated as quickly as possible.

By the middle of winter the male showed signs of the reproductive season. Besides vigorous exercise for hours every night he chewed to bits several of his wooden wheels and cardboard nest boxes. One night his wheel got stuck so it could not revolve and he chewed much of it into sawdust before morning. The female was quieter but in fine condition, plump and vigorous and fully as large as the male.

On April 15th I brought their cages onto the sleeping piazza, where I could watch them at night, and put them in one cage. They soon got to fighting, and I had to take one out and let it run on the floor until morning. Then it entered its own nest box and was put in the cage where the other was in its nest. There was no more fighting until evening, when it began again as soon as both became active.

The male was always the aggressor and the female on the defensive, but the fighting was savage and often bloody. Teeth and claws were sometimes used, but the long, straight, sharp-pointed toenails were the real weapons that could be used with deadly force in forward thrusts or downward kicks.

After three or four days and nights, they became less savage and would go into the same nest box in the morning and sleep together peaceably. On April 25th, and for several successive nights, they were seen mating, but the exact date of conception could not be definitely determined.

By May 1st the weather was too warm on the piazza, so they were removed to the animal room in the basement where they could not be so closely watched. I supposed they would be friendly for some time.

But on May 6th I heard them fighting in the night and in the morning found the male badly injured, torn, bitten and punctured by the teeth and toenails of the female, who was unmarked. It was, of course, the result of abnormal conditions. The male would have left when his usefulness was over but could not get away, and the whole instinct of the pregnant female was to keep her house and food stores for her coming family. He would not retaliate, and he could not escape. It was my mistake, not their fault.

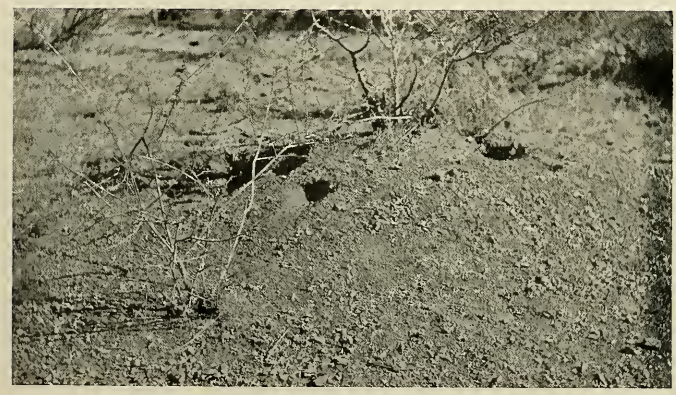
On May 12th, at 7:00 p. m., I felt in the nest and found a young one just born, and at 10:00 p. m. there were three of them, all dry and warm and pink and very helpless. The period of gestation was apparently only seventeen days, unless my observations were not correct. Only 27 days had elapsed since they were first placed in the cage together and had to be separated.

When the young were twelve hours old, I weighed, measured and photographed them. They were tooth-

[1] Life History of the Kangaroo Rat—Bull. 1091, U. S. Department of Agriculture, Sept. 13, 1922.

Obviously remarkable as an example of physical adaptation, the four-toed kangaroo rat has also developed high mental, moral, and economic standards which enable him to thrive in dry, scorching deserts. His plumy tail, which serves as rudder, balancer and brace, is clearly shown dangling from the human hand *(below)*. It has earned him the popular name Bannertail. The kangaroo-like leg structure *(left)* is a highly perfected digging mechanism. Furry-soled, long, hind legs propel him at great speeds and equip him for extensive burrowing

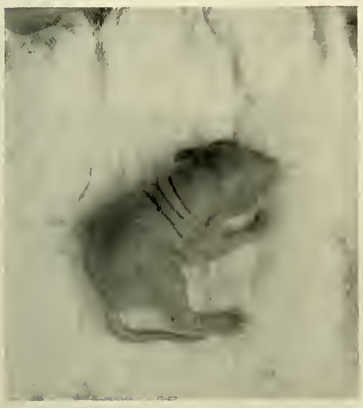
In mounds like the one shown below, these beautiful little denizens of America's southwestern deserts build their roomy homes and storehouses. They are thrifty providers, and they jealously defend "home rights" against intruding snakes, scorpions, and tarantulas



When force fails, bannertails resort to strategic retreat through these amazingly complex tunnels and galleries *(left)*. Somewhere there is a rear outlet to well-known roads leading on to other mounds and secret burrows. Such resourceful engineering feats are of strong survival value in a dangerous invironment

(Right) A BANNERTAIL'S TREASURE CACHE unearthed from a well-stocked underground pantry and spread on paper. When measured it was found to be two quarts of seed-laden patagonica heads

(Below) BANNERLESS bannertail, aged 12 hours. He is dry, warm, pink, and very helpless. The period of gestation is probably less than three weeks. Mating among bannertails, at least in captivity, proved to be preceded by a relatively bloody fight, and woe to the prospective father who does not keep a safe distance while his mate prepares for the event. At eight days *(below right)* the young bannertail's eyes are not yet opened, but the velvet parti-colored fur indicates his future markings



(Below) THOUGH her back is turned, Mother Bannertail is a most solicitous guardian of her young, for whose warmth and comfort she skillfully wove a ball of cotton. When anyone approached she would try to hide them

(Below) CLAMPING with her small forelegs and seizing him with her teeth, Mother Bannertail proceeds to take her wandering 23-day-old boy back to the safety of the nest, leaping a one-foot barrier in the process

less, hairless and wrinkled, with eyes and ears closed, but they showed the color pattern of adults in lighter pink where the white markings were to be. When disturbed they uttered little squeaking sounds like the mouse-sized crying of a baby.

At three days old the color had darkened and fine, silky whiskers had grown to a quarter of an inch in length. At a week old the hair had appeared as a dark, velvety coat with white markings sharply outlined.

When twelve days old the incisors had appeared as little sharp points, not hooked or curved as in some rodents. At fourteen days, their eyes opened. At sixteen days, they were again weighed, measured and photographed.

By June 18th they were half as heavy as their mother and by September 26th they were practically full grown, the largest male weighing 132 grams (about ¼ pound), six grams more than his mother. Weights and measurements were taken at intervals.

From the first the mother was very solicitous for the young, hovering and nursing them in the big ball of cotton she had skillfully woven under and over them and herself. It was clear that there would be no place for a big-footed male around in the way. In nursing them she sat over them and spread her feet apart and her body as wide as she could to give the young access to her four slender nipples far back on the abdomen. I never saw them nursing from the single pair of breast nipples.

While the young were small, she would try to hide them when anyone came near, either spreading herself over them or picking them up one at a time in her mouth and tucking them into the cotton at the back of the nest and covering it up. She would just grab around them with her mouth wide open.

The young began to come out of the nest box of their own accord when about eighteen days old, but were not allowed to stay out. When the mother discovered them, she would grab them up, carry them back and stuff them into the nest box. Soon they were too large to be held in their mother's mouth, so she would take hold of a fold of skin and then with both arms around the body, go hopping along on the big hind feet to the nest box. One time when excited by strange visitors, she caught up one of the young, hopped onto the wheel and went spinning away as if carrying it far from danger.

Another time, when I was trying to photograph them in a box on the roof, she picked up one of the young by the scruff of the neck and, with her arms around it, jumped out of the box and started to run away.

The young, when picked up by the mother, always kept still and if put down for a new hold, did not move. Their obedience was implicit.

Later, however, when they were about half-grown the play spirit developed, and they got the idea of running on the wheel, a twelve-inch disk nicely balanced at an angle on a pivot. They liked the motion of the wheel but at first were slow and clumsy and kept getting in their mother's way. After stumbling over one in her swift revolutions she would grab it up and impatiently spring to the door and stuff it into the house; but it would soon come out again (sometimes all three of them) until she became fairly cross, as she was kept busy putting them back to bed. Finally, however, they gained more skill and would all run on the wheel together in a row around the edge, keeping perfect time and step and making it fairly spin under their dancing feet. If one turned, they all turned, and none would ever get in the way of the others. The wheel was kept busy most of the night, and sometimes one would come out in the daytime to take a spin.

Their play spirit was conspicuous. When a pile of fresh sand was put in the pen, the young would roll and rub and nose into it with great enjoyment, frisking, shaking and then combing their coats and tails.

No home of their own

When they were half-grown and weaned, I thought they might have more fun if by themselves, so I gave them a nice cage and wheel and a nest with plenty of sand and food; but they soon became tired of it and lonesome and tried to jump out. The mother also was worried and restless. So after half an hour's experimenting, I returned the three young to their old house and mother, to the great satisfaction of all. The mother carried them all into the nest box and tried to keep them there, but they would not stay and soon were all on the old wheel, running together. We never tired of watching them run and admired their teamwork, skill and speed.

On June 6th, when 25 days old, they were first seen filling their cheek pouches with seeds and rolled oats to be carried into the nest box in the morning. For several days they had been seen eating rolled oats, seeds, and green leaves of clover and lettuce. When given a piece of watermelon, they nibbled and licked it a little but got their hands wet and went away to wash them in dry sand. They would not touch it again.

The adults are generally voiceless except for drumming and tapping and vibration sounds, but the young have many little squeaky complaining sounds. One at 37 days, waiting his turn on my desk to be weighed and measured and feeling lost and lonesome, made several little whining sounds as if calling for his mother.

About the middle of July, when nearly full-grown, the young began storing all excess food, seeds, grain, rolled oats and the green food all cut into short sections. It would be packed under the wheel with all the sand scraped up around and over the wheel to make a mound. At night the animals were often surprised with their bulging cheek pouches full of food to be cached, though most of it had to be moved only six inches.

When more sand was supplied they scraped or kicked it up over the nest box, packed the door full in the daytime and cut a ventilation hole in the back upper corner. Storing and mound building had begun, though on a small scale compared with their elaborate storage mounds in their native deserts. Boxes provided for food were soon filled up, but all slept together in one ample nest box, with closed doors in the daytime. Apparently the young of the family stay in the mound until full grown and through the first winter.

One morning in midwinter, I found the dead, torn and mangled body of a deer mouse that had been kicked out of their house with other refuse. It had evidently gone into the nest box to find food and warmth but met a savage reception by these storers.

Later my old grasshopper mouse *(Onychomys leucogaster)* got out of her cage and ran into their nest box. There was a violent disturbance inside and in a moment one of the bannertails came boiling out, shaking its nose and acting very peeved. Then another came out and soon two more. I grabbed into the nest to catch "Ony" and instantly got a savage bite through the end of my finger that made the blood run. Evidently she thought I was just another bannertail to be evicted. She had already vanquished about twelve times her own weight of good fighters, but had taken them at a disadvantage in too close quarters. In one of their own roomy mounds, the fight might have had a different result. However, this throws some light on the closed-door policy of these defenders of home rights.

In their desert mounds they have many intruders to contend with, snakes, lizards, centipedes, scorpions, tarantulas, weasels, and numerous rodents that would like to share their houses, stores and comfortable nests. Closed doors and self-defense are not always sufficient protection, but windows of escape and numerous well-known roads leading to other mounds and secret burrows are available in case of dire need.

It is only through such complete adaptation to a difficult and dangerous environment that these beautiful animals have been able to maintain themselves in considerable abundance in limited areas when competition is not too severe.

Conversely, the constant strenuous effort for ages of time has developed structure and habits, as well as mental, moral and economic standards, that enable them to carry on.

From the little we know about them, it seems possible that the lives of bannertails may be just as perfect, complete and far advanced in the scale of physical evolution as ours.

DO NOT MISS

THE FOSSIL MAN OF CIRCE'S MOUNTAIN, wherein Albert Charles Blanc relates a scientific "murder story" with its setting in the Old Stone Age. The "corpse," a Neanderthal skull, revealed mutilations similar to those perpetrated by Melanesian cannibals in recent times. Was the long extinct Neanderthal Man a cannibal? And did he believe in the survival of the soul?

Though golfers curse his depredations on their putting greens, Man owes **THE FRIENDLY EARTHWORM** a debt of gratitude which has been long overdue. Herbert S. Ardell makes a down payment in an article demolishing many a myth about this lowly creature and showing how his persistent activity creates much of our national wealth.

The eagle has ruled Man's imagination since the dawn of Time, unfurling five thousand years of history behind his wings. Lucy Embury does full justice to the "King of Bird's" eventful history in her nimble and colorful **ODYSSEY OF UNCLE SAM'S EAGLE.**

Dr. Edwin H. Colbert, whose article on the prehistoric fish, "A Fossil Comes to Life," proved one of the most popular subjects published last year in NATURAL HISTORY Magazine, will soon tell the story of one of the most important conflicts between mind and mass strength the world has ever witnessed. The mammoths, unsurpassed in size by any other land animals of their day, strove to live on earth at the same time that early man was feeling the power of the most highly developed brain that had ever been created. Do not miss this scientific glimpse of the animals our ancestors of the Ice Age had to contend with—animals that have died so recently in the geologic sense that the dogs of modern explorers have fed on their flesh.

BIOGRAPHER OF THE INDIAN

The story of Clark Wissler, an American Anthropologist who played Boswell to an entire race

By D. R. Barton

THIS IS A "STAGE" INDIAN . . .

An old lady, so the story goes, declared that she knew all Indians walked single file because she saw one once. So it is with many of the characteristics we attribute to the first American. We have seen the particular Indian shown above so often in our literary and theatrical melodrama that we believe every redskin wore a feathered headdress and a phlegmatic expression.

As to the headdress, it was originally the exclusive cultural property of the Sioux and Crow tribes who used it in ceremonies and warfare. But we have so strongly imposed our notion on the Indians of today that representatives of all tribes are adopting the Sioux costume and will probably incorporate it into their respective folklores as the universal ancestral garb.

In regard to the phlegmatic expression, we are nearer the truth. But we seldom realize that the red man's stoical qualities, far from being inherent, came of deliberate striving after a cultural ideal. Thus the "typical Indian" is not much different from the "typical Englishman" who is traditionally opposed to the "volatile latin," lacks a sense of humor, and cannot express emotion in the presence of third parties.

Many of us have testily imputed to the Indian a susceptibility to liquor that is due to "sheer weakness of character." This attitude betrays our ignorance of aboriginal culture as well as the facility with which we forget our own part in the matter.

The Northern Indians never had any alcohol of their own because the demands of a nomadic hunting culture simply did not allow them sufficient leisure time to discover the art of fermenting. Such luxuries are invariably the products of higher cultures where a scheme for division of labor has been instituted and where the idle pleasures of social drinking do not vitiate the constant watchfulness imperative among lower and hence more vulnerable organizations, in the grim struggle for survival.

Thus when the white trader arrived with his whiskey barrel, the Indian drank until he could drink no more, with the same spirit he had always shown during an unexpected windfall of food. For the idea of temperance is impossible among a people unaccustomed to abundance.

Out of the red man's tragic experience with alcohol have come many of the bibulous words in the American language, of which "fire-water" is certainly the best known. White contributions to the Indian's downfall are, however, significantly revealed in "bootlegger"—a term coined on the early Indian Reservations where we made one of our first "noble experiments"—and in "Manhattan" which probably can be translated as "place of the big drunk."

If a cow were to disrupt my slumber by systematically devouring the straw mattress from under me, I would feel more than justified in resorting to harsh and, on some mornings, extreme measures of retaliation. If there be any who sympathize in this, they should be willing to reconsider the case of the Dog in the Manger, a parable which has always seemed to strain the allegiances. Probably we side with the cow in this episode, largely because that animal is an important cog in our bustling, workaday world. The cow wants to eat the hay and convert it into milk and other bone-building dairy products, thus playing a considerable if unconscious part in the march of progress. On the other hand, the dog is simply lying down, enjoying the warmth and pleasant odors of the hay, a pastime with which we builders of empires are totally out of patience.

Our attitude used to be much the same toward the Indian. We found him enjoying the country but doing nothing useful with it. He was simply snoozing, as it were, rather than trying to make a bigger and better continent. Therefore we regarded it as something in the line of duty to take it away from him.

Of course, today we have ceased our vituperations and can review the past with somewhat kindlier eyes. Indeed,

a good many people are now quite friendly to the Indians, a turn of events which is due in no small part to the slow infiltration of scientific knowledge about the red man and his way of life.

History has taught us that the substance of a book can sway nations, even though the actual reading audience is comparatively small. And so it has been here. For no book has spread the whole truth about our aborigines as has Clark Wissler's classic *The American Indian*. Nor has any man shown wiser sympathy with a lost cause than its author. He has played Boswell to an entire race, recording its enviable achievements and its richly varied customs with clarity and a reverence unmarred by emotional reformism.

At the turn of the century his was the rare experience of watching a major culture disintegrating before his eyes. About 1890 the plains buffalo had become virtually extinct and there came a great depression in the Indian country that struck with no less crippling suddenness than the financial cataclysms of our own civilization. The loss of the buffalo was totally unexpected. It had seemed an inexhaustible animal species to white and red man alike. But one day it was there no longer. The Indian's great natural source of food and clothing was gone. Each month another tribe was herded onto a white man's reservation. And within less than a decade these Indians were wards of the United States Government, one and all. Social gangrene set in almost immediately. Myriad generations of environmental selection had fashioned the plains Indian to be warrior, hunter, and free man of action. He could not remake his personality overnight into that of a vassal farmer. He was doomed and he knew it.

So did Doctor Wissler. Commissioned by the American Museum of Natural History's Anthropology Department, he set out to jot down the wealth of still-living ethnic material before it disappeared altogether. Often journeying by stage coach, he passed from one little "concentration camp" to another, learning not only a great deal about the first Americans but a surprising lot about his own race as seen through Indian eye.*

The endless train of disillusionment and misunderstanding which followed the bewilderment of early Indian legislation had made these social prisoners intensely suspicious and disdainful of their white overlords. But they liked this quiet, unassuming young anthropologist. He was interested in the old customs and the old weapons. He did not order them to do any of the new things. And he liked nothing better than to listen to their stories. He lived in their wigwams, rode with them on the trail, and eventually was adopted by the Blackfeet tribe under the name of He Who Gets What He Goes After.

Illustrations by IRWIN WEILL

Early days

Though he was born as far back as the 1870's in a state significantly named Indiana, this predestined member of the Blackfeet tribe lived out his boyhood without ever seeing a "real" Indian other than the protagonists of traveling medicine shows. But his great grandparents had been original settlers in this territory, and many a "real" Indian stalked through family reminiscences. They were friendly braves for the most part and thus he started life with a favorable impression of the people whose unwritten culture he was later to salvage from an imminent oblivion.

His birthplace was a rural village

* A fair share of this unique view of ourselves can be found in the pages of this magazine: XXIX, 307-317; XL, 625-630; XLI, 108-112, 185-189, 271-274; XLII, 121-126—and more completely in Doctor Wissler's book, *Indian Cavalcade*, Sheridan House, 1938.

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The MILWAUKEE ROAD

of six houses surrounded by farmland. And it was the owner of one of these farms, an industrious collector of Indian artifacts, who inspired him to take up the study of aboriginal life. This Wayne County farmer was in fact the first of two teachers, drawn from curiously different walks of life, whose devotion to their specialties deeply influenced the direction of young Wissler's career. After school, the boy would tramp about the fields unearthing arrow heads and other more complicated specimens of an old-time handicraft. His farmer-tutor had evidently read up on these artifacts in the anthropological literature of the day, and was so conversant with their history and uses that his pupil had little to unlearn in later life.

The second decisive turn in his development as a social scientist came at the University of Indiana, where he came under the influence of the psychologist and subsequent college president William L. Bryan. Professor Bryan apparently had something of his famous namesake's gift for persuasive oratory. At any rate his lectures made so great an impression that Wissler at once decided to major in experimental psychology. For psychology was new and exciting in the nineties. So new, in fact, that instructors felt pressed to keep pace with their inquisitive students. In the laboratory at Indiana, the class split into groups, some of which played willing guinea pigs for the others. Here young Wissler studied reaction times, vision, muscular development and memory. Though this may sound routine to a psychology student of today, the work was doubly fascinating since these "pioneer students" kept trying to develop the techniques best adapted to each new phenomenon rather than relying on experiments which had already passed into the category of formal exercises. In this laboratory was discovered the famous "plateau graph" of progress in learning, which is one of the established laws of modern psychology.

Clark Wissler felt the impetus of this association with young men eager to press back the horizons of a new science, and while still very much an undergraduate, he undertook altogether new work on muscular activity.

Dividing his classmates into three groups, he started them wiggling a particular muscle in the hand every day for two weeks. Group A kept wiggling to the point of exhaustion, Group B until discomforted, Group C only a minute or two. Their examiner found that individuals in each group showed marked advance, independent of their method of exercise, and concluded that individual variation was a more powerful determinant than learning methods. Later, at Columbia University, he continued this work and once wrote a paper on the "transference of practice" which demonstrated that exercising a given muscle or set of muscles in the right hand would show a relative increase of ability in the left. This phenomenon is apparently best explained by the theory that the corre-

THE TALL TRUTH

LARGE FAMILIES

Among fishes large families are commonplace. A cod or tarpon may lay four million eggs or more. Though only a small percentage of these eggs hatch, a sufficiently large number of young will wriggle their way out of danger to ensure a new generation. Their struggle for existence is severe, however, and the vast majority fall victim to other fishes. Only enough reach maturity to replace the parents—except under changing environmental conditions.

Mammals, on the other hand, have relatively few offspring. At the low end of the scale of fecundity is the elephant. After fifteen years of age the female may have one calf about every two and a half years, with a possible maximum of 20 young in a lifetime.

Though guinea pigs have often been the subject of wit as to their rate of multiplication, wild ones have relatively few young—one or two, twice a year. In domestic strains the number of young increases to as many as eight, and there may be four litters a year.

The most rapidly reproducing mammal known to the ancients was the European wild rabbit. As many as nine young are born at a time, and in favorable years there may be six or eight litters. Females of the first litter may have young the same year, but such families are not large. Its fertility made the rabbit highly esteemed among the peoples of Europe and accounts for its association with Easter, probably through the influence of an earlier pagan fertility festival.

But the meadow mouse, or vole, may exceed in fecundity even the European rabbit. Though the number of young in a litter is about the same, the meadow mouse may have several more litters in a year. Furthermore, whereas young female rabbits do not bear young before six months, young meadow mice of spring and summer litters bear young at about nine weeks. This makes quite a difference in the reproductive rate.

Though death and irregularities prevent it from happening in Nature, a pair of meadow mice could theoretically produce several thousand descendants by the end of the first year, and thereafter the number soon becomes astronomical.

JOHN ERIC HILL.

sponding chain of muscles in the left arm carries out a "self-exercising" reaction in pure sympathy with those in the right. That is, if you go through the exercises of turning a key in a stiff lock with your right hand, your left will exert itself similarly so that if you keep it up over a period of time, the left hand muscles will develop along the same line as the right hand muscles—though not, of course, as extensively.

While still at Indiana, Wissler served as an instructor *even before* he received his B.A. degree and was subsequently called to Ohio State. All those who have taken "psych" at Columbus can thank (or curse) Clark Wissler. He inaugurated the University's Department of Psychology.

Museum beginnings

From Columbia University on Morningside Heights, you came down town by horse-drawn streetcar. At 81st Street they had plowed under the encircling corn field that had once balked curators on their way to work. And, walking east from Amsterdam Avenue you no longer passed goats grazing in open meadows—a common sight when an obscure bank clerk, named Frank M. Chapman first entered the Museum about ten years previously. But you could still see steam locomotives pulling elevated trains along Columbus Avenue, Admiral Dewey was the Lindbergh of the day, McKinley was President, and Roy Chapman Andrews was getting to be just about the best taxidermist in the whole town of Beloit, Wisconsin, on the morning Clark Wissler paid a call on Anthropology Curator Putnam. This meeting took place a short while after Columbia's Department of Psychology and Anthropology had split into its component parts, and Doctor Wissler, who had never forgotten the Indian lore of his childhood, had gone over to the Anthropologists. Curator Putnam, perhaps the most famous man in the field at that time, asked the young Columbia instructor whether he would not like to do field work among the plains Indians. Doctor Wissler jumped at the chance. Curator Putnam was succeeded by Franz Boas, who retired from the Museum a few years later, at which time Doctor Wissler became acting head of the department. One year after that, he assumed his place as the Museum's full-fledged Curator of Anthropology, a position he has held ever since.

Continued on page 253

NATURAL HISTORY Magazine offers $5.00 for any items found suitable for publication under the title, *The Tall Truth.* Unsuitable contributions cannot be returned.

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EXPLORATION IN BORNEO, NEW GUINEA & SOUTH AMERICA

AMERICA'S TREASURE

- - - - - - - by W. Maxwell Reed

Harcourt, Brace & Company, $3.00

IN this day of many books, it is a rare occasion when one appears possessing an essentially new treatment of the subject with which it is concerned. *America's Treasure,* by W. Maxwell Reed, edited by Carey Croneis, Associate Professor of Geology at the University of Chicago, is one such book. For not only is it concerned with such tangible geological treasures as gold, mercury, borax, copper, lead, silver, iron, aluminum, phosphorus, coal, petroleum and building stone with some discussion of bronze, soil and soil erosion, but there is also a consideration of the more intangible treasures represented by the physical and mental vigor of the people of this country.

The discussion of the geological treasures is in most cases a somewhat oversimplified and generalized statement as to the origin of the ore bodies and a few pertinent figures as to production and consumption, with, for some of the minerals, a short discussion of the known reserves available for future recovery. On the whole, this section of the work is well done, though since it enjoyed the editorship of Doctor Croneis it is difficult to account for one or two serious factual errors which occur. There is no scientific basis for the statement (p. 104) that the coal beds of the Appalachian region were formed during the Silurian period. Lapses, such as the implication that all graphite is of igneous origin (p. 38), or that the trees now found fossil in the petrified forest of Arizona grew in the sea (p. 66) are probably to be attributed to an overly stressed desire for simplicity of language and treatment.

In the latter part of the book there is a very interesting series of chapters comparing the production and consumption of world treasures by America (here always considered as solely the United States) versus the rest of the world. It is concluded that the Americans are as a people more energetic mentally and physically than other world groups. To test this conclusion the author undertakes an analysis of a list of the great inventions of the world and credits 40% to the United States. He also analyzes the results of the eleven major track and field events which have been contested at the ten modern Olympic meets. In each of these meets the Americans have won the majority of these events. The conclusion drawn from these analyses is that we are a superior people physically and mentally and that there is no evidence of deterioration in this superiority under the burden of our great wealth. I am inclined to quarrel with the emphasis placed upon the Olympic records as indicative of physical superiority. Much of the credit here seems due to the superiority of our coaches and trainers. Success in many of the events listed depends upon trained muscular coordination and finesse, not upon pure strength alone.

H. E. VOKES.

THIS WAY SOUTHWARD

- - - - - - - - by A. F. Tschiffely

W. W. Norton, $3.50

THE subtitle "A Journey Through Patagonia and Tierra del Fuego," is perhaps misleading, for the author's trip by car from Buenos Aires to the Straits of Magellan, and a short visit to Tierra del Fuego via commercial air line, form only a part of his account. Much of it consists of a re-telling of favorite Patagonian stories of the "old days," some of which seem to be improving with time. Patagonia is full of good stories, and undoubtedly many people will find this entertaining reading. From the material presented, it is doubtful if the average reader would get a particularly good or complete picture of the country and its present inhabitants.

Treated at some length are the stories of the Welsh settlement of the Chubut Valley, the legend of El Dorado and the City of the Caesars, and the attempt by the Frenchman, Orllie Antoine, to establish a kingdom among the Araucanian Indians. Writing of the extinct and surviving Indian tribes of Patagonia and Tierra del Fuego, he shows that he has failed to check his information when he makes mistakes such as mentioning Chonos as having lived in Tierra del Fuego. The same is true of his remarks on the natural history and geography; viz. the present existence of oysters in Fuegian waters, his misuse of Toxodon for Myledon when speaking of the remains found in the Ultima Esperanza cave, and his placing of the City of Punto Arenas "at the Pacific outlet of the Strait of Magellan."

JUNIUS BIRD.

BEGONIAS

New York Botanical Garden, 25¢

A 44-PAGE booklet of articles reprinted from *The Journal of the New York Botanical Garden,* containing information of interest to the gardener on the culture, history and classification of begonias.

NEW GUINEA EXPEDITION

- - - - - by Richard Archbold and A. L. Rand

Robert M. McBride & Company, $3.50

NEW GUINEA has always been one of the outposts of exploration, zoological as well as geographical, though little by little it is giving up its secrets under the impact of modern methods of investigation. The most important contributions of recent years have been made by the expeditions sponsored and led by Richard Archbold, with Doctor Rand as ornithologist. Their primary purpose has been the collection of museum specimens of birds and mammals and the study of these creatures in the field, but broader objectives have been attained. Some of the important discoveries made by the expeditions have found their way into print in the scientific publications of the American Museum of Natural History, where the two authors of the present work are Research Associates in Mammalogy and Ornithology, respectively, and others are awaiting publication. The volume in hand is an account of the second of the three expeditions made to date and is, we understand, largely from the pen of Doctor Rand.

When the first of the expeditions, in 1933, encountered the usual difficulties of primitive transport that have handicapped explorers of New Guinea from the earliest times, it was planned to make the second effort more effective by the use of the most modern equipment. A combination of air, land, and water transport was put into operation in 1936 with the greatest success until an unfortunate accident necessitated a sudden change of plan. Headquarters were established on the coast from which personnel and equipment were taken up the Fly River by boat to the highest point that could be reached in this way. From this river station, exploration was extended to the mountains with an amphibian plane to keep all the advance parties supplied with food and other necessaries carried from the coast and dropped by parachute. All this was preceded by extensive reconnaissance flights to determine the best routes of inland travel.

The plane was destroyed by storm while at anchorage on the coast, but a portable radio advised the advance party of this so that they could act accordingly. A chartered plane brought in sufficient emergency supplies to get the advance unit back to the river. There rafts were built to carry men and equipment downstream to a point where they could be reached by a rescue launch, and the entire expedition reached

the coast without serious mishap. Although the hoped-for exploration of the higher mountains was not now feasible, the loss was made up, at least in part, by the exploration of more accessible localities near the coast.

This, in brief, is the framework on which the text of the present book is built. There are no attempts to startle or horrify the reader or to emphasize the heroics of an explorer's life such as may be found in certain recent books. By contrast, there is a straightforward narrative of events interspersed with careful observations on the natural history and the peoples of the regions visited, giving a clear picture of an interesting expedition carried to a successful conclusion under adverse conditions.

It is unfortunate that the photography of the expedition was not more successful. There are more than a hundred photographic illustrations in the book, all of them of interest, but many have been made from imperfect or damaged negatives, retouched but still unsatisfactory. A good series of sketch maps puts the reader into adequate touch with the geography of the region and the routes followed by the expedition.

J. T. Z.

THE BOOK OF DIAMONDS

- - - - - - by J. Willard Hershey

Hearthside Press, $2.00

THIS most recent book on gems is principally concerned with the stone of the title. Comm ncing with a summary of some historical information about diamonds and diamond superstitions, it then gives an account of the occurrences of the rough, arranged in an historical sequence. The description of the New South Wales, Borneo and Chinese occurrences is very interesting.

Doctor Hershey, who is the head of the Chemistry Department at McPherson College, then discusses the properties and tests for diamonds, describes cuttings, ancient and modern, and gives an account of some of the historic stones. A short chapter then mentions briefly a number of other gem stones, probably in justification of the color plate at the front which is reprinted from another publication. Another chapter gives an indication of the qualities of diamonds and points out some of the possible faults of individual stones.

The last, and longest chapter of the book discusses experiments made by Doctor Hershey's predecessors in the synthesis of diamonds, but without an evaluation of their work, and tells of the experiments carried out in the Chemical Laboratory of McPherson College by the students and Doctor Hershey. He describes in detail his method and some of the variations introduced in the hope of obtaining larger stones.

The book is not very well written and there are many misprints, as "incubes" for incubuses, "Travinier" for Tavernier, and "enrided" for goodness knows what. Many of the geological statements indicate that the author's knowledge of that science is rather sketchy. Tests made by the Gemological Society of America did not confirm the authenticity of any of Doctor Hershey's "synthetic diamonds."

F. H. POUGH.

MOUNTAINS IN FLOWER

- - - - - - - by Volkmar Vareschi

Photographs by Ernst Krause

Macmillan, $3.00

MOUNTAIN peaks have ever fascinated mankind. The strength, majesty and beauty of the peaks give to the mountain climber an experience which is difficult to convey to his less fortunate fellows. In the superb photographs of alpine flowers which illustrate this book, something of this mountain spirit has been captured and brought to earth for the reader. In obtaining this atmosphere the photographer has taken many close-ups of flowers on the edges of cliffs and rocks and used as a background the Dolomite Alps of Europe. With each of the seventy-two of these incomparable pictorial records the author has written a short essay about the flower or some related phase of mountain climbing or botany. These are personalized narratives in a style somewhat similar to that of Donald Culross Peattie; poetic, yet simple, prose which introduces a wealth of interesting botanical facts as well as folk-lore.

In an appendix are listed some of the "dry facts"; the names of the plants, the family, the place where each photograph was taken, the color of the flower, the distribution and other short notes on the subjects treated in the text.

This is a most attractive book for the library of those interested in the flowers of the European Alps whether from the viewpoint of the mountain climber or the grower of alpine plants.

J. W. THOMSON, JR.

GRAPHIC GRAFLEX PHOTOGRAPHY

- - - - - - by Willard D. Morgan and Henry M. Lester

Morgan and Lester, Publishers, $4.00

THE art of photography has slyly slipped into man's life almost like a sixth sense or a new member, to help him see, to help him remember, and at times to hold him spellbound with its very beauty. The team of Willard D. Morgan and Henry M. Lester, who previously published the *Leica Manual* and other works on photography, have soundly established themselves as experts in giving the public the best advice on how to take pictures.

Their new book is based on personal contacts with over 5000 users of the Graflex and the Speed Graphic. It is the new source book and working manual for all larger camera users. While not written especially for the natural scientist or the outdoor hobbyist, the art and technique of photography are so vital in these pursuits that few will fail to gain in skill and enjoyment through the inspiration of this book. A list of the kinds of pictures it helps you take would include practically every phase of life from sport to science and from the nursery to the stage. In respect for its contents, your reviewer foregoes giving a topical analysis, leaving it confidently for inspection by the individual, like a gift that is to be opened on Christmas.

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add interest and meaning to a volume, which in text and layout, is a masterpiece in exposition. This redounds the more to the credit of Mr. Morgan and Mr. Lester, for they are the authors, compilers, and publishers as well. It is books such as this that inspire admiration for the way in which the gifts of civilization are made useful today on a broad scale, enabling man to lift his head above the clouds—in this case, simply because he carries a little black box with a window in it.

E. M. W.

OUR NATURAL RESOURCES AND THEIR CONSERVATION

- - - Edited by A. E. Parkins and J. R. Whittaker

John Wiley and Sons, $5.00

IN this second edition of a comprehensive work by 23 authors, which may yet be rated as one of the classics in its field, an effort has been made to eliminate some of the duplications of the 1936 text and at the same time to increase the cross-referencing. All quoted statistics have been brought up to date and an entirely new chapter on the conservation of commercial fish has been added.

In a book of such highly multiple authorship, uniformity in point of view or in readability would, of course, be out of the question. Thus certain parts of this work remain somewhat discursive or even obscure. Its best purpose will doubtless be served if it is used chapter by chapter in relation to the very many aspects of conservation covered within its 647 pages. Particularly gratifying, according to the point of view of its authors, is the recent gain in conservation-mindedness among the American population as a whole, and the stalwart support of the cause that has grown out of purely recreational interests.

R. C. M.

THE WORLD UNDER THE SEA

- - - - - - - by B. Webster Smith

D. Appleton-Century Co., $3.00

THIS attractive, popular little volume aims to give some knowledge of, and stimulate interest in, the physical characteristics and particularly the living inhabitants of the sea, in their endless variety. The opening chapters, "Our Knowledge of the Ocean, and Whence it Comes," and "The Bottom of the Sea," which will give the uninformed an introduction to the modern science of Oceanography, are the most satisfying. The major part of the book sketches a picture, worth while in its broader aspects, of the life in the ocean, by more or less brief mention of a great number of living forms. These range from the minute drifting "plants," diatoms, which form a basic food supply for the inhabitants of this vast stretch of waters, to fishes and great whales; and from creatures which ride the waves that dance in the sunlight at the ocean's surface, to the grotesque fishes which swim in the cold perpetual night of its depths.

It is only fair to author and reader to say that we have here something which seems to have been written in large part offhand, rather than put together in a scholarly manner, and too much reliance should not be placed on its details. The spectacular is often stressed, rather than the significant being explained. Anyone who has been much at sea may be disappointed with the scant mention if any, of to him familiar and interesting phenomena. In the large amount of factual matter presented there are many misleading statements, and some that are ridiculous. For instance we find concerning live-bearing sharks, "The young, which at first are only about an inch long [!], remain close in-shore during their first summer and winter." As a matter of fact such young sharks are more nearly a foot long at birth.

The book is easy reading, and even those who have already considerable knowledge of one or another of the phases which it touches, if not too critical, may gather useful information from its pages. The wealth of illustrations, for the most part good, give visual demonstration of the variety of marine life. And it has a useful index.

J. T. N.

THE COMPLETE GUIDE TO SOILLESS GARDENING

- - - by Dr. William F. Gericke

Prentice-Hall, Inc., $2.75

THE use of nutrient solutions in the growing of vegetables and flowers has received a great impetus during the last few years, due to the publicity attending the published results of experiments conducted by investigators in various parts of the country. Doctor Gericke was the first to demonstrate that certain crops could be grown on a commercial scale by the use of these solutions and he has continued his experiments for more than a decade. As a result he writes with authority on a subject that is bound to attract more and more attention as time goes on.

In this book Doctor Gericke traces the history of Hydroponics and gives the reader as thorough an understanding of the subject as it is possible to obtain up to the present time. He does not agree with the claims of phenomenal yields and huge profits from Hydroponics but points out that certain crops can be grown profitably while others cannot, due to the cost of equipment and materials. Some crops, such as corn, that could not be grown at a profit by themselves may be double-cropped with potatoes and the two grown at a profit.

Each crop requires special handling and no two can be treated exactly alike; the differences are pointed out, and at the same time it is noted that personal experience is necessary in order to obtain the best results. Inasmuch as the author deals with the subject thoroughly, and in an interesting manner this book will be found necessary by those who wish to practice Hydroponics as a hobby in their homes and by those who desire to grow crops commercially by this method.

C. H. C.

BIOGRAPHER OF THE INDIAN
—Continued from page 249

The field work which he undertook for the Museum was the already mentioned commission to spend five summers among the newly established Indian reservations in the Dakotas, Montana, Alberta and other localities east of the Rockies. At each reservation he followed essentially the same procedure: (1) To collect artifacts. This is perfectly aboveboard and invites the confidence of Indians while classifying the investigator as a harmless nut. (2) To open conversation with Indians by suggesting that they have the same customs as a neighboring tribe. This brings hot denials, and soon several of the leaders are heckling each other in the interests of accuracy. (3) To depart the instant you get the feeling of not being wanted. This latter strategy was usually very rewarding since, on your return, the Indians welcomed you as a long-lost friend.

Doctor Wissler found that the Indian instinctively responded to friendly treatment and was ready to meet anyone more than half way as soon as his deeply ingrained suspicion of the white man was broken down. Wissler was absolutely honest with them at all times and, perhaps more important, respected their privacy. He would ask about a secret society and when told that such things could never be divulged to a white man, he would honor their reason for refusing and politely drop the subject. Then after a time they usually got around to the secret societies themselves and told him everything he wanted to know. In return, he took them into his confidence, told them just how the information he was writing down would be distributed to the anthropology profession at large, and described what the Museum was like. They felt complimented to think that a building in the white man's city was anxious to house their tools and garments, and that a set of men who were expert in the magic of writing took an interest in the lore of their tribe.

Of course, none of the white men could ever understand why he wanted to hang around listening to "a few lazy old Indians telling lies." It was still a rough and tumble country with stage coaches and occasional mail robberies, roistering cowboys, and a few odd gun-fighting characters left over from the days of the true frontier. Yet upon them all, Indian and white man alike, had come a time of change

INFORMATION TEST

A few informational high spots that may be gleaned from this month's NATURAL HISTORY

Score 10 points for each correct answer. Correct answers on page 256

1. Columbus saw the Indians wearing full feather headdresses.

   True..... False.....

2. If you exercise a muscle in your right arm for a reasonable time, the corresponding muscle in your left arm will also be measurably strengthened.

   True..... False.....

3. Where did our word "bootlegger" originate?

4. To what state would you go to find America's most beautiful land shell?

5. Scientists have satisfactory proof of why each prehistoric animal became extinct.

   True..... False.....

6. So far as we know, mental diseases are non-existent among savages.

   True..... False.....

7. While the dinosaurs became extinct, the more primitive *Sphenodon* survived down to the present day because of

   a. Superior fighting equipment

   b. Isolation from enemies

   c. Sheer force of numbers

8. Fill the following blank: class, order, family, genus, ————

9. The New Zealand reptile the *Sphenodon* has

   a. Three legs

   b. Three eyes

   c. Three toes

10. The American Indian is a natural born "poker face."

    True..... False.....

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and readjustment. Doctor Wissler was a young man viewing objectively, and for the first time, a changing social complex of which he was not intimately a part.

But it was not his last opportunity of the kind. As director of the Museum's Archaeological projects in America's arid southwest (1909-1925) he saw mute and broken evidence of prehistoric change, in pottery shards. These fragments passed through distinct vogues, cycles, and styles, though they were nothing more than shattered cook-pots, culled from the refuse of red men who lived in apartment houses when Park Avenue was a mass of brambles, Vanderbilt a very obscure Hollander's place-name meaning "from the heap," and Columbus a wandering Genoese crank.

Later, in 1924, while exploring the island cultures of the Pacific, he saw evidences of change everywhere. In each place it took a different shape and direction, yet it was always there. From his own observation and from those of students in the Museum and elsewhere, he reached the conclusion that change in human life was simply a phenomenon by itself. No compact theory of causation could account for all its protean manifestations.

One style in native art goes out and another comes in. Yet there is no elaborate advertising and sales machinery "to put over" the latest rage. Likewise, an entire human culture will collapse and another will succeed it. In many cases scholars can show a set of determining materialistic causes which certainly seem to have brought about the downfall. In all cases they can show *some* obviously contributing factor such as a disastrous crop failure. But they cannot explain all of the downfalls, all of the time. Nor is the problem restricted to mankind. Paleontologists have been sore beset to understand exactly why several of their giant beasts became extinct. A sudden drought might cut down sharply on their food supply but seldom could it be proven sufficiently calamitous to wipe out every last male and female of any well distributed species. Thus change—in the sense of that mysterious inner disintegration which historians call "decadence"—seems to be a mammalian rather than a peculiarly human phenomenon. Nor is Doctor Wissler confident that we will be able to isolate its essential, causative principle. However, one thing is certain. Change there must be. It will come whether the institutional machinery of a given culture is complex or simple, nor can man, for all his piety and wit, restore or retain the old order.

And yet, when we heed the admonition that there is nothing new under the sun and consider that all the basic techniques in pictorial art were well known in the Stone Age, we cannot doubt the paradox of permanence in the midst of flux. In one place after another, Doctor Wissler has seen human life shot through with this contradictory phenomenon of sameness. In Australia he visited a modern hospital, situated close to the hunting grounds of naked savages. Interned were patients taken from among these hardy people of the bush, who were suffering from nearly every disease known to white men, including certain tropical fevers to which aborigines had long been supposed immune. Primitive women are universally alleged to bear children as a mere incidental routine. But many cases in the maternity ward at this hospital, would surely have died in the bush. For it was found that they were subject to every known obstetrical complication. Meanwhile, in the psychopathic division, a native turned disdainfully from the physicians, convinced that he possessed a secret invention making him the most dangerous man in the whole world. Another was certain that everyone was dangerous, each one bent on killing him. A third *was* dangerous and felt periodically compelled to murder. And so it went. Delusions of grandeur, paranoia, homicidal mania, manic depression, schizophrenia—all the mental aberrations of civilized man have afflicted his primitive brothers and are probably among the ills that flesh has been heir to since the beginnings of tribal life. Although there is such a thing as racial susceptibility, racial immunity is an exploded myth. By his pathology you shall know him, since mentally and physiologically men are pretty much alike everywhere.

The same general personality types appear in a tribe in Rhodesia or a village in Rhode Island. But each group has responded to a different environment, and out of the vast store of creative potentialities common to both, each has stressed a different potentiality, expressed through the radically different grooves of their culturally inherited behavior patterns. However, despite the obvious complexity of this situation, anthropologists converging on their subject from the three vantage points—of archaeology, and cultural and physical ethnology—have managed to trace the broad outlines of a species behavior peculiar to Man alone.

They are just beginning on the staggering task of filling in the details. And perhaps they never will reach the point of solving that eternal bugaboo—which of man's characteristics are inherited and which acquired? "In the present state of our knowledge," says Doctor Wissler, "it is practically impossible to shake conditioning out of human experience and say what you started with." What can be done, however, is to study all available varieties of Man's experience. And nowhere is there greater diversity than among our primitive contemporaries.

"I cannot help but wish the good old days could come back for the Indian," Doctor Wissler writes. "In imagination the Indian sees joyful meat eaters gathering around the evening campfire, muffled in warm buffalo robes. Yet it is a vain hope, for at best it will be but a counterfeit of the good old times when West was West and Indians were Indians. Popular sentiment is rapidly being won to the cause of Conservation and much laudable progress has been made toward the preservation of the birds and the beasts. But let us not forget that all over the world primitive man is being destroyed. The prevention of this deserves the best scientific thought of our time."

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Solar Snapshots

By CHARLES H. COLES

Chief Photographer, American Museum of Natural History

TWO solar eclipses this year will renew interest in photographing our daytime star. One of them occurs in April, while the other will be seen in October. Both of them will be photographed and in the process special techniques must be employed to allow for the extremely bright surface of the sun. Nowhere in our earthly experience do we encounter light intensities that approach those of the solar surface.

The eclipse of April 7th will be annular in Florida and partial over the eastern part of the United States. An annular eclipse occurs instead of a total eclipse when the moon is so far away from the earth that it appears too small to cover the sun when it is in front of it. The sun then appears as a ring (annulus) about the moon. This will enable photographic experimenters over a large area to try their luck at making pictures of the partially obscured sun. The eclipse of October 1st will be invisible in the United States although it will have a total phase in Brazil and South Africa.

What cameras to use

Almost any camera may be used for this type of photograph, but a camera with a focal plane shutter will permit the use of higher shutter speeds and long focus lenses. The longer the focal length of the lens, the larger will be the image of the sun. The sun's disk will have a diameter of about 1/100th of the focal length of the lens used.

If the lens of the camera is removable, a portrait attachment or spectacle lens may be used to take the place of a long focus photographic lens. To reduce the aberrations of such a simple lens, a narrow band-pass filter must be used. In this way the chromatic aberration is circumvented. Spherical aberration is reduced by stopping the lens down with a black paper diaphragm. Speed is not wanted in the lens system, so this stopping down does no harm.

In mounting a lens of the spectacle type, a cardboard tube must be cut to the right length to make the lens focus the sun's image on the film plane. A lens of less than two diopters (more than 20 inches) will prove unwieldy unless an elaborate lens supporting system is built. The lens may be held to the end of the tube by adhesive tape.

Filters

There are several kinds of filters that may be used for photographing the sun. Neutral density filters merely cut off light to the point where the shutter in the camera can take care of the reduced light intensity. A piece of fogged film that has been developed to a fairly deep black is a neutral density filter that works quite well. A simple test of its efficiency is to hold it up and look through it at the sun. If the sun is clearly seen and of a comfortable brilliancy the filter will work well at about 1/25th of a second on Verichrome film.

The second type of filter is the narrow band-pass filter mentioned before. This filter or combination of filters reduces the color of the light passing through it to

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APRIL MUSEUM BROADCASTS

"Preview of Annular Eclipse of the Sun" from the Hayden Planetarium. Mutual Network, 5:45 p.m., E.S.T., Saturday, April 6th.

"Annular Eclipse of the Sun" from Jacksonville, Florida. Columbia Network, 5:00 p.m., E.S.T., Sunday, April 7th.

o o o

"New Horizons" (Natural Sciences, History and Geography), Columbia Network on Wednesdays at 9:15 a.m., E.S.T., and 2:30 p.m., C.S.T., with Dr. Roy Chapman Andrews.

"Men Behind the Stars" (Popular Astronomy and Mythology), Columbia Network on Fridays at 4:15 p.m., E.S.T., with Prof. Wm. H. Barton, Jr.

"This Wonderful World" (Information quiz on Natural History subjects), Mutual Network on Saturdays at 11:15 a.m., E.S.T., with Robert Emory and Robert Coles.

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practically one wave length. It is used to reduce the chromatic aberration of simple lenses and thus aid in producing a sharp image. Combing Wratten Filters No. 15 and No. 45 will be found useful for this purpose.

Sometimes a deep red filter is used on orthochromatic film to cut down the light from the sun. Inasmuch as the film has practically no sensitivity to red light this method is very effective in reducing the photographic intensity of the light. Wratten Filter No. 72 is a good one to experiment with.

Making the exposures

When the day of the eclipse arrives, the camera is pointed in the direction of the sun and fastened on a tripod. The long dimension of the film should lie in the direction of travel of the sun in its daily journey.

Warning! If your camera has a focal plane shutter made of rubberized cloth, do not let the sun enter the lens unless the filter is in place. If this warning is not heeded, a puff of smoke from your camera will announce the burning of a hole through the shutter.

From the *Nautical Almanac* or other sources of astronomical information, find out what time the partial phases will begin. Start your exposures somewhat earlier so that the uneclipsed sun appears first in the series. Make one exposure every five minutes on the same film without moving the camera. The sun will have moved enough during the intervals between exposures so that the images will not overlap. If you happen to be where the eclipse will appear as annular, then your central exposure will show that phase also. Since no corona is visible in an annular eclipse, it is of little interest to astronomers.

This eclipse will give a good opportunity to polish up your technique, so that in the future if you happen to be in the path of a total eclipse you will have had some valuable experience.

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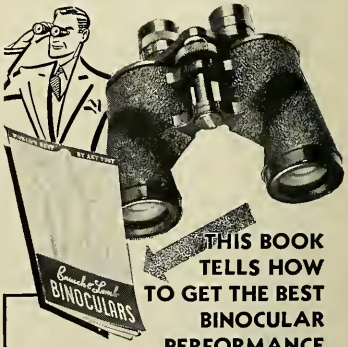
Answers to Questions on page 253

1. False. The feather headdress was the exclusive cultural property of the Sioux and Crow tribes of the Western Plains. See page 246.
2. True. This is because of a sympathetic reaction which takes place unconsciously. See page 249.
3. The word "bootlegger" was first used on Indian reservations of the late nineteenth century. See page 246.
4. Florida. See page 216.
5. False. The sudden violent upheaval of Nature may account for the decimation of a species but does not always mean complete extinction. See page 254.
6. False. Savages are known to suffer most of the more prevalent psychoses. See page 254.
7. (b) Isolation from enemies. See page 231.
8. Species. See page 224.
9. (b) Three eyes. See page 225.
10. False. See page 246.



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George W. Garey with world's record broadbill swordfish weighing 842 lbs. caught off Tocopilla, Chile.

A 714 lb. black marlin caught off Talara, Peru, by G. P. Seely, Jr.

May NATURAL HISTORY 1940

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F. Trubee Davison

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Natural History

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Above illustration from Bird Group of Hudson Bay Region in the American Museum of Natural History

LETTERS

SIRS:

Two years ago this spring, I had a very thrilling experience observing and photographing this nest of the great blue heron. It was located in a beech, about 80 feet from the ground. Climbing irons were necessary to reach the nest. Each time that I climbed the tree and neared the nest, the female would set up a series of harsh squawking, that resounded throughout the whole woods.

The photograph of the eggs was taken on April 16th. The photograph of the almost naked young was taken on May 8th, when they were not much over a week old. The third photograph was taken exactly two weeks later, when the young were quite feathered out.

EDWARD MACARTHUR.

Cleveland, Ohio.

SIRS:

I have just been reading the article, "How Totemland Was Carved," by John C. Reed. The story is fascinating and calls to mind a mystery that has never been fully solved in my own mind.

The mystery is that of the Ice Age. What caused it, what changed it, how can it possibly return? These questions have often run through my imagination.

My own theory of the Ice Age is that it was caused by a change in the inclina-

Continued on page 310

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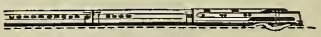

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NATURAL HISTORY

The Magazine of the American Museum of Natural History

FREDERICK TRUBEE DAVISON, President — ROY CHAPMAN ANDREWS, Sc.D., Director

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THE MOST AMAZING

Ewald Gnilka photo from Three Lions, Publishers

(Above) CHAMELEON'S HEAD greatly enlarged. The peculiar conical eye can be moved in all directions, independent of the other one. If the chameleon were as large as shown here, its tongue would shoot out to a distance of some three feet. *(Chamaeleo chamaeleo)*

TONGUE IN NATURE

Commonly celebrated for his color-changing ability, the chameleon distinguishes himself more spectacularly by his deft use of a rapid-firing tongue which is longer than his body

By Robert Cushman Murphy

At first you see nothing but a tangle of green, nearly leafless vine, supported by a few dead black twigs. Next, the tiny flashing of opalescent wings shows that a host of insects is scattered throughout the labyrinth. They seem to be the only denizens of this microcosmic African jungle.

But look sharply, for something is happening to one of the sticks; it is conjuring itself into a black, lifeless-looking creature with withered limbs. It might have died a month or a year ago, only to dry up on the stalks it resembles.

Look beyond, among yellowish-green withes of the vine, and you will spy a similarly ancient object, except that this one is of an olive tone like the surroundings in which it lodges.

But the black monster in front is coming to life. It has shifted its skinny hands, with barely perceptible movements, to a neighboring twig, and now, with the stealthiness of only a chameleon, it pulls its length along after them. Sneakingly, ever so softly, the crooked hind feet loose their hold upon the first perch. The tail, likewise looped around it, sluggishly uncoils; all but motionless actions gradually transfer the spellbound lizard to its chosen point of vantage. Then, splitting its cloven feet around the new twig, it awaits the gifts of fortune.

Stillness is its first principle, and yet its frozen pose is not quite complete, for uncanny eyes that work like independent searchlights continually jerk about without any sign of a common purpose. The eyes are housed in cone-shaped barrels, and by using each singly the chameleon can look in any direction without a bend of the spine or a crook of the neck. While one impossible eye is star-gazing, the other is directed backwards. Suddenly the creature stares straight ahead in a moment of bifocal vision, but just as abruptly one tube of the disjointed optics pops out at a right angle to the head, and the small bright orb—the sole convincing sign of inner life—bears upon an oblivious fly a foot away. Not a stir anywhere escapes the intent reptile, whereas its own movements are now limited to the manipulation of its telescopes.

The chameleon, as an embodiment of patience, is the Job of Nature. He wastes no time in pursuing

(Below) A drawing, *about ⅔ actual size, showing the otherwise sluggish chameleon in action. Its well-known color-changing ability is an important aid in hunting, but without this extraordinary tongue it could not secure the alert insects upon which it depends for food. A seven-inch chameleon has been known to shoot a fly twelve inches away*

Drawing by G. Frederick Mason

nimble insects. You might surmise that he understands the law of chance. A fly walks up his shrunken, weather-beaten, leather side and receives no more attention than the proverbial gnat on a bull's horn. A fly settles on the twig behind him, but his only response is to point briefly one sleepless evil eye; the other is likely to be functioning simultaneously elsewhere. What kind of image can such dissociated equipment produce in the little ogre's none too excellent brain?

At last a blissful fly has alighted upon a twig nine or ten inches from the chameleon's snout. In the first response of concentrated attention, the watcher's cannon-like eyes swing forward in their shriveled portholes and hold a common aim. The fly, with naught in its world to disturb it, ceases to stroke its wings. The whole scene is one of rest. The chameleon opens his hard, dinosaurian jaws slightly, as if to yawn, and from the mouth a clubby pink tongue protrudes. An inch, two inches, three inches it slides slowly forth. How futile! A good seven-inch span of safety lies between the slimy tip of the tongue and its intended victim.

Perhaps the chameleon has given up hope, for, quicker than human sight can follow, the tongue snaps back into the mouth. But wait—the insect has not flown. It has merely vanished, and to the hunter we must turn for an explanation, because the hunted has had no time to know that anything has happened! From its comfortable isolation to the grinding mill of the jaws it has been whisked in a twinkling. The mouth of the living corpse is champing, though silently, and the burning eyes are once more peering askew toward unsuspecting flies among the vines.

How is it done?

For more than a century the mechanism of this accomplished tongue has presented a fascinating problem to naturalists. It has long been known that a chameleon with a seven-inch body can shoot a fly twelve inches from its nose, and that the whole process is comparable in speed with a flash of lightning. The way in which the tongue is used, therefore, offers a unique opportunity for studying nervous and muscular organization, and the details have been learned only within the last few years.

The tongue, together with the hyoid bones that form its basal support, represents only a modification of the familiar equipment of all backboned animals. It consists of a fleshy terminal knob armed with "mucilage," and an extensible hollow stalk, into the soft, partly inverted tube of which the knob fits when it is retracted. The bones and their muscles are so arranged that the root of the tongue can be carried forward remarkably close to the tip of the lower jaw. In the mouth the tongue remains always in a position of readiness. In other words, the spring is set before the chameleon pulls the trigger.

The massive tongue knob is a ring-muscle, known to anatomists by the expressive term *musculus accelerator linguae*. It is made up of a series of circular discs around a sheath, and each disc is composed in turn of small bundles of radiating fibers, the directions of which are reversed in alternate discs. It is the sharp contraction of the ring-muscle on the tapering and slippery end of the median hyoid bone that causes the astounding explosion a second or two after the end of the tongue has been slowly thrust from the mouth, pulled by hyoid muscles on either side and drawing the expanding stalk behind it. The plan of the weapon might be said to combine certain features of the stretched rubber bands of a slingshot with the extraordinary propelling force obtained by squeezing a wet watermelon seed from the tips of thumb and forefinger!

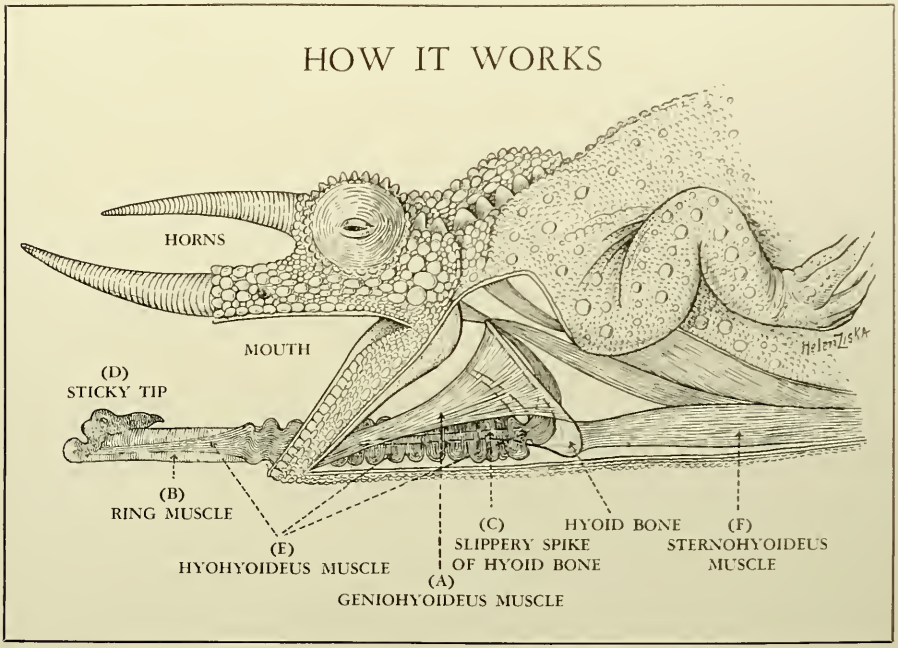
The projectile, however, must not only strike its game but must also bring it back. This is the point at which the elastic stalk serves the function of a lanyard. When at rest, the tube of the stalk is shortened and thickened along its bony peg, the forward end enclosing the base of the knob like a turned-back glove finger. Within its walls the muscle-strands, nerves and blood vessels are thrown into folds more intricate than the twists of any meandering river. Not the least surprising part of the whole rapid insect-catching proceeding is that such delicate tubes and tracts can be jerked out to the taut limit of their extension without rupturing.

The routine, when the chameleon brings his artillery into play, is, therefore, somewhat as follows: first, the stimulus of the prey, which comes to the lizard only by sight; second, the complicated nervous response that causes it to open its mouth and slowly stick out the tongue knob while at the same time it is calculating aim and range with its two converging eyes; third, the fly-catching snap which comes when protrusion is succeeded by projection; and fourth, the final process of retraction or snapback, which carries the prey into the mouth, thus starting mastication and releasing the eyes for divided attention to the world roundabout.*

Fossil bones of the chameleon's probable ancestors have only recently been discovered in Cretaceous rock, laid down toward the end of the Age of Reptiles, perhaps 70 million years ago. The various kinds of chameleons that live in the world of today, how-

* *The structure and physiology of the chameleon's tongue, as studied since the year 1805, are covered in the text and bibliography of a paper by Dr. C. P. Gnanamuthu, in the* Proceedings of the Zoological Society of London, 1937, *Vol. 107, pp. 1-63.*

ever, must be regarded as modern and very highly specialized lizards despite their primordial aspect that suggests the boredom of remembered eons. As is evident, their talents are few but adequate—otherwise the weird little beasts would not have survived for parvenu man to watch. Their power to change color, which enhances the concealing effect of motionlessness, has become a metaphor. The tongue which goes forth on such long forays to bring home the bacon in small but frequent portions, would be sufficiently astonishing in a fever-heated creature like a hummingbird. As the food-gatherer of a being characterized by cool blood and profound torpor, it must be classed as one of the foremost marvels of evolution.



THE TONGUE of the chameleon is projected from the mouth in somewhat the same way that a watermelon seed can be shot from between the fingers. The tapering, slippery bone (C) inside the powerful muscles of the tongue might be called the exclusive feature of the chameleon's remarkable invention; the other muscles and bones differ from our own only in detail. The chameleon projects his tongue as follows: he opens his mouth and draws the whole tongue apparatus forward like a gun on its carriage by contraction of muscle (A). After careful aim, the powerful ring muscle (B) contracts suddenly on the slippery spike-like bone (C), shooting the tongue forward on its rapid journey, which has just begun in this drawing. Extremely elastic, the tongue projects to great length. The insect struck adheres to the sticky tip (D). The tongue is then withdrawn by contraction of the elastic tissue and the "accordion pleated" muscle (E); and the muscle (F) pulls the "gun carriage" into the back of the mouth.

Three horns, two of which show here, distinguish this chameleon from others, but the tongue mechanism is essentially the same. *(Drawing by Helen Ziska based on a dissection by H. C. Raven)*

Adventures in PUFFIN-TOWN

The mating season comes to a land-hating bird of northern seas, whose family and social life provide one of Nature's best comedy acts

By Olin Sewall Pettingill, Jr.
Instructor in Zoology, Carleton College

With Photographs by the Author

Their laughably human demeanor, their seemingly insatiable curiosity, and their interesting community life make puffins the most fascinating subjects of observation. I contend that they well fill the "comedy niche" occupied by the penguins of southern seas, which of course are not found in northern regions. Let me support my contention regarding the puffin personality by recalling my adventures in Puffin-Town.

Puffin-Town, the one of which I speak, is Machias Seal Island at the mouth of the Bay of Fundy off Maine's northeastern coast. Because it is a mere few acres of land, or to describe it another way, a ledge and many loose rocks emerging abruptly above the high tide mark, it is not indicated on small maps. Nevertheless, to ornithologists it is an important geographical area, for it represents the one important breeding ground of the Atlantic puffin along the shores of the United States. In addition to the one species of North Atlantic puffin, there are three North Pacific species.

During the bleak winter months Puffin-Town, as such, is absolutely nonexistent. No puffins are to be seen about the island; they are scattered at sea, though presumably not many miles distant, for they do scant migrating.

But in blustering mid-April a few individuals suddenly, quietly appear in the rough water near the surf-pounded shore. They watch and circle the island in obvious but timid interest. Days pass and many more individuals gather; a few make quick but voiceless courtship flurries over and under the waves. Gradually their interest in the island becomes intensified but no less timid. Several birds rise from the water (a task for puffins), fly hurriedly over the island and look down at it inquiringly. Reconnoitering flights, I suppose. Still not one bird has put its feet ashore.

When faced with this perennial nesting urge, puffins somehow lack the exuberance and courage of the land-loving birds. And perhaps for good reason. Puffins are closely adapted in foot and wing to the wild open sea, a world comparatively free of predators. The nesting urge means for them a precarious, varied environment where scores of enemies lurk, a world against which they have relatively little physical protection. So energies that might be expended on bold, elaborate courtship displays are instead devoted to the one serious matter of readjusting themselves temperamentally to the hazards of a strange but temporary abode.

In a way I am sorry for puffins in April, though I confess their shy approach to lonely Machias Seal Island—the most harmless environment I know—is almost funny.

By the first of May several individuals, driven to new daring by an instinctive impulse, suddenly drop down on the highest rocks, to stand rigid with fright. And Puffin-Town is refounded. This involuntary bravado instills courage among the onlooking associates, and soon they follow. In a few days Puffin-Town is bustling with activity. By the last week of May the community is organized: a cool, dark crevice among the loose rocks belongs to one pair of birds, a sheltered cranny under a jutting ledge-shelf to another, while the tops of all the high rocks remain public property—like the common of a New England village. On each such area all residents have equal and uncontested space for landing, loitering, and taking off.

In 1932 the total population of Puffin-Town reached approximately 800 individuals. Actually the

community occupied only the southwestern section of Machias Seal Island, the place where the rocks were highest and the crevices largest and deepest.

The erection of my steel-framed, burlap-covered blind in the midst of Puffin-Town one day early in July, 1932, quite disrupted communal harmony. Inadvertently I had selected for its site one of the highest flat-topped rocks because I thought it a fine place from which to view the entire colony. I did not know that I had usurped one of the favorite commons and thereby angered a number of puffins.

At first I did not go into my blind but stood off about 100 feet and, through binoculars, watched the reaction of this highly organized colony to this unexpected, disconcerting change in environment. For some time the puffins circled dizzily and excitedly. Finally, those occupying the outskirts of Puffin-Town farthest from the blind began gradually to land, facing the slight offshore wind as they did so. It was a matter of a half hour or so, however, before the birds living in the immediate vicinity of the blind accepted it as a part of their surroundings and alighted beside it.

(Left) PUFFIN-TOWN'S *"common": on all high rocks puffin residents have uncontested space for landing, loitering and taking off*

(Below) THIS *sedate member of Puffin-Town surveys Machias Seal Island before hazarding the precarious job of refounding the colony*

Convinced that my blind would cause no further disturbance, I turned away to make preparations for entering it. I gathered my notebooks, camera, and "puffin gloves." Imagine my astonishment a few minutes later when, ready to move toward the blind, I saw two puffins sitting on its hammocky top. My blind was a new common! Little did I realize that in a few hours it would be a most popular common by reason of its new height above the majority of rocks, that puffins would be vying with one another for a perch on its extremely limited but comfortable surface.

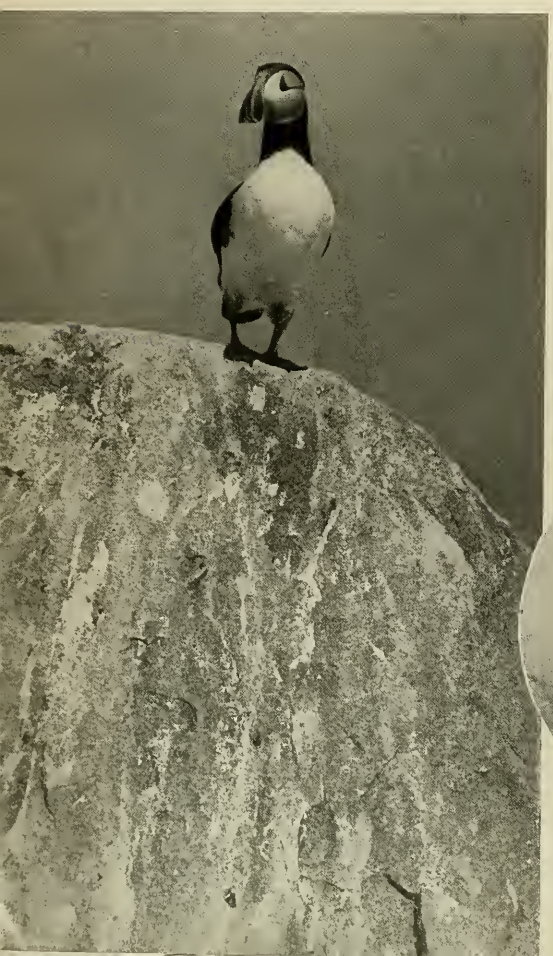
I had never looked at a puffin's face; my knowledge of its physiognomy came from bird paintings and photographs. To me the greatly exaggerated features, elaborate coloration, and seriocomic expression seemed almost too good to be true. So I shall not forget my keen anticipation when, once I had concealed and folded myself in my blind, the puffins began to circle lower and lower. The close-up of a puffin was about to materialize.

At last a puffin plopped onto a common beside me. "Plopped" is the word, too! A puffin is heavy bodied and, while it can fly swiftly ahead with its short rounded wings and stubby tail, it finds it a cumbersome feat to land with such equipment, particularly with little wind for support, as on this day. I realized this even more as I watched a second puffin flying over the same place again and again. Deciding to come down, the bird checked its forward flight abruptly in mid-air and started to descend vertically in autogyro fashion, sharply beating its wings all the while. In spite of quick wing movements, the drop was even more sudden than that of the first puffin, as the wind had momentarily subsided. With legs spread wide apart the puffin landed sprawling ridiculously on the rock. But it was not in the least abashed; it pulled itself to its feet, extended and flipped its wings several times, thus simultaneously rearranging its plumage and resuming its composure. Shortly thereafter other puffins followed suit in the same clumsy way, until all the commons were occupied.

What a sedate, quiet population I looked out upon! The puffins stood perfectly still on their bright red, webbed feet; they moved their heads slowly from side to side, focusing first one eye on the blind and then the other. I believed that they expected the structure to come to life at any moment. I noticed at once their absolutely flawless attire. With immaculate white underparts in sharp contrast to jet-black backs, wings, and tails, they looked like miniature men dressed in formal clothes with their hands in their pockets.

But I was particularly impressed with their exotic faces. Of course, their features were essentially alike; yet I imagined I saw variations in facial expression, due undoubtedly to the varying angles and positions from which they looked at the blind. Some seemed possessed of an unbounded curiosity and ability to ask innumerable questions; others seemed bewildered, perplexed, dumbfounded. There were just a few, as there are in any community, that appeared overbearingly wise.

I began to wonder how long it would be before Puffin-Town would go about its own business, before the curious, the dumbfounded, and the wise would start paying attention to their daily affairs—when a puffin alighted on the top of my blind. Its feet sank deeply into the loose burlap. Here was an opportu-



(Left) THINKING *of taking off. Unable to take flight from a level surface, puffins patter up to the highest rocks to jump out into the wind. The author's blind* (below) *became a new and popular "air field" because of its height over the majority of rocks*

nity. I could pinch its feet and thus hold it captive with one hand; with the other I could reach through a peephole and bring it below. There was only one difficulty—a puffin's beak is capable of delivering a vicious bite. Luckily I had my "puffin gloves," the heaviest winter gloves I owned. Putting them on and making certain of the location of the bird's feet, I made a successful grab.

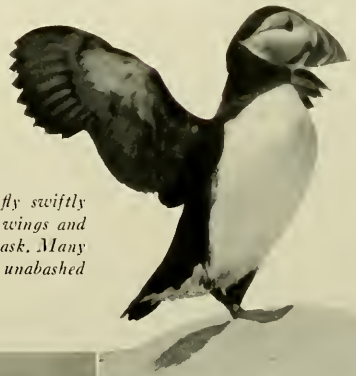
The struggle that followed can be easily imagined. The captive bird fought desperately, tried to pull itself into the air, bit helplessly at the vise gripping its feet. Puffin-Town was panic-stricken and an evacuation ensued. Out to sea they dashed; back came the curious, the dumbfounded, and the wise. They circled to study the source of the alarm, cocking their heads and looking down on their luckless neighbor with either a "what's the matter" or an "I told you so" attitude. In the meantime I carried out my plan and brought the frustrated puffin down into the "den of horrors." Strangely enough, it had uttered no note of complaint. This was unbirdlike in the extreme.

Once I had obtained a firm hold on my tough-bodied, pigeon-sized prisoner, I emerged from my blind and headed toward the level, grass-covered center of the island and away from disrupted Puffin-Town. Here was my chance to give a puffin the once-over, even if I had to handle it with gloves.

I had not studied and probably never shall study a more remarkable avian face. The forward half of the high, narrow beak is red, the basal half deep blue and distinctly framed in a yellow fillet. The mouth is lined with yellow, with bright orange corners; while the rest of the face is grayish white. This strange color combination gave me the weird feeling of looking at a mask hiding the features of an ordinary bird, a mask actually seeming to be tied on by a white line around the back of its head. Each eye, triangular in shape with a dark lash-like line extending back from it, suggested a chink carelessly cut in the mask and properly penciled to lend a Mongolian expression. Of course, the eye proper was perfectly oval with bare, vermilion lids. The illusion of three-sidedness was due to two bluish scales, one above the eye and the other below it, and the illusion of lashes was due to a peculiar fold in the skin back of the eye.

All of these features of a puffin's face I meticulously examined until the experience of handling a puffin was no longer novel. I was about to give it freedom when I suddenly realized I had not seen its nostrils. Why not? Certainly every bird must have them. The truth is I had not looked at the bird's face from below. This I did in a last minute search and found two narrow, slit-like openings almost at the very cutting edge of the beak. I am at a loss to explain the reason for this unique position of the nostrils, if there is a reason.

I was due for another surprise when I placed the much-mauled puffin on the ground in the belief that I had finally liberated it. The bird, though perfectly normal in every respect, was unable to take off from the level surface. But it was not lacking a method for getting into the air. Toward a high ledge with sloping sides it made a beeline. Keeping its wings partially outspread as an aid in retaining balance, it



(Left) WHEN WADDLING *out into space, puffins partially outspread their wings to help retain a balance. After the take-off, they struggle upward like a heavily loaded transatlantic plane*

(Below) LANDING. *While puffins may fly swiftly ahead, their heavy bodies, short, rounded wings and stubby tails make landing a cumbersome task. Many a puffin suffers a ludicrous sprawl with unabashed dignity*

(Right) FLAWLESS ATTIRE—*"a miniature man dressed in formal clothes with his hands in his pockets"*

"PUFFIN GLOVES" *thwart the puffin's sharp beak*

(Above) ABOUT *to regain his prized freedom*

floundered through thick grass, stumbled over hummocks, and once fell headlong into a hollow somewhat hidden by dead grass. Decidedly winded, half crawling with its wings, it ultimately reached the foot of the ledge, pattered up to the summit, and jumped off unhesitatingly into the slight wind. Its wings beat fast but hardly fast enough. Gravity pulled its plump body earthward and it bounced severely along the tops of small rocks. By dint of good fortune the puffin had gained sufficient momentum in its descent to sustain flight, for, when an unhappy landing seemed imminent, the bird began to rise like a heavily loaded transatlantic plane and was safe in the air.

No other resident of Puffin-Town suffered the experience of this individual. I had no desire to upset further the daily routine of these birds by capturing them and making them unnecessarily distrustful of the blind. During the following days the blind was accepted as a part of the neighborhood, while my comings and goings caused them only momentary disturbances. To me the blind was a medium whereby I was placed in touch with the happenings of Puffin-Town.

Never had I observed a seabird colony where there was such a noticeable absence of vocal sounds. In tern, gull, and skimmer colonies there is generally so much harsh screaming and rapid, loud gabbling that the effect is almost deafening, and continues whether the colonies are disturbed or not. In Puffin-Town emotions seem not as a rule to be expressed orally. When the sounds come they are few and far between and match perfectly the birds' solemn appearance. They are notably sepulchral in tone and resemble more the lowing of cattle in a hay-filled barn than they do the vocal efforts of birds. They give no suggestion of frivolity and excitement and affection. As a matter of fact, the birds never open their mouths when they utter them and never change their expressions.

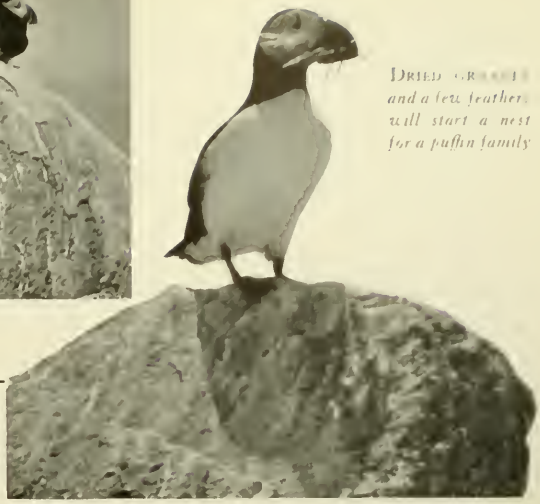
Puffin-Town always retires at nightfall. Here again I noted a marked departure from the behavior of colonies of gulls and terns and skimmers, which remain nearly as active by night as by day. Not long after sunset, or much earlier if fog darkens the sky, puffins begin to disappear. Some return to the sea to spend the night on the waves; others pass the night among the rocks below. This "going to bed" process is no mass movement: it takes place slowly, as one individual after another either deliberately takes wing or walks out of sight into the natural crevices. Invariably a dozen or more individuals linger on the higher commons much longer than the others, leaving only when their white "waistcoats" are barely discernible in the twilight. But even they depart individually. Throughout the night Puffin-Town sleeps silently. In comparative safety the poor-flying, land-hating puffins thus await another day.

The location and even the activities of Puffin-Town are undoubtedly governed to some extent by the wind. This is accounted for by the fact that puffins, unlike gulls and terns, more or less need wind for take-offs and landings, although such flights may be accomplished without it. Thus, Puffin-Town is located on the southwestern portion of Machias Seal Island so as to get the full benefit of the steady sou'-westers. Upon these winds they can climb easily in a take-off, and against them they can alight without too heavy a jolting. Should these winds not be available, the rocks are sufficiently high above the sea to allow the birds a considerable drop in which to gather momentum in a take-off. On windy days the commons are used to a great extent as loitering areas, but on still days the birds are reluctant to spend time here and come only for nesting duties. Apparently the wind gives them a feeling of security. Without it they would be unable to escape quickly and alight comfortably.

I never ceased to enjoy the daily activities of Puffin-Town, for they were manifold and gave me no dull moments. The following incidents that occurred almost simultaneously one late July day show what I mean.

Two puffins dozed on the top of my blind. Three others sat on a rock not five feet from me. One preened its feathers systematically, running its beak along successive wing feathers. The queer-shaped beak was used as dexterously for this purpose as the typical bird beak. A second puffin merely crouched and gazed lazily at the sea. A third slept with its beak wholly tucked under its scapular feathers. On a nearby common two puffins were settling a grievance by a tug of war. Struggling with beaks interlocked, one managed to pull the other so successfully across the rock

PUFFIN-TOWN *always retires at nightfall*



DRIED GRASSES *and a few feathers will start a nest for a puffin family*

that it absent-mindedly fell off backwards, carrying the other bird with it into a crevice. In a few moments one of them reappeared alone, straightened out its ruffled plumage with a quick flutter of wings, and jumped off into the wind. Later the other bird lumbered sheepishly into view and settled on a rock for a rest.

During this fracas two puffins had been standing perfectly still on a ledge a few feet away, glaring steadily at each other. Perhaps it was some sort of endurance contest to see which could hold the position the longer; perhaps it was a subtle form of combat; perhaps it was some restrained bit of courtship behavior. I will never know, for the contest, or whatever it was, ended undramatically when one of them casually moved away. In the meantime I was highly entertained by one worried-looking puffin scurrying about from rock to rock with its mouth full of feathers and grasses. Obviously it desired to build a nest but could find no place in which to start it. All suitable crevices among the rocks were occupied. Every so often it would take new courage and disappear into a likely crevice, only to reappear discouraged as a result of the threats of the occupants.

Without doubt the most amusing performance to

(Below) PUFFIN *parents take turns incubating their lone egg*

(Below) "BILL-CLICKING"—*a favorite pastime in Puffin-Town*

be observed in Puffin-Town is that which I have called "bill-clicking." Two puffins will approach one another and, without uttering a sound, proceed to slap the sides of their bills together. A decided clicking noise is produced. The performance often continues for several minutes and quite frequently attracts other loitering puffins to the scene. They may look on, supposedly fascinated, or perhaps enter the performance, thus increasing the participants to three, four, and sometimes as many as six. Occasionally bill-clicking becomes a regular free-for-all.

So far as I am able to determine, bill-clicking is a form of social play. It occurs in Puffin-Town at any time, even late in the nesting season. So it is not necessarily a courtship antic, although it may serve to heighten the mating impulse when it occurs earlier in the breeding season. Evidently it is not a form of combat, for the birds appear altogether too mildly disposed toward one another at the time.

I could not see the nests from my blind, because they were located in the dark crevices which the birds had selected earlier in the season and were usually out of arm's reach. They were made for the most part of dried grasses and a few feathers crudely heaped together and cupped on the top to contain the lone, whitish egg.

Both sexes are equally attentive in keeping their one precious egg at uniform temperature during the long 36-day incubation period. Again and again one individual would be seen suddenly disappearing down one of the dark passageways. Moments would elapse and its mate would reappear out of the same passageway and scan the surroundings with satisfaction, apparently glad to be in the open again. Sometimes it would stand bolt upright, stretch and yawn. Sometimes it would crouch to bask in the sun or head out to sea in search of food. Not infrequently during this exchange of incubation duties, as one puffin met its mate in the crevice, I would hear sonorous sounds—vocal recognitions in the puffin manner.

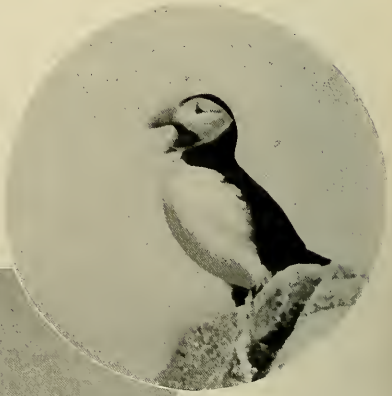
The result of a puffin egg's hatching is a disappointment. One would expect a tiny creature as comical and as appealing as the parents. Instead the result is a plump, slow-moving, semi-precocial* chick in long dusky down, with a typical chick bill, dull, blurry eyes and black feet. Removed from the nest and placed on a rock in the sun, the homely youngster strives to return to its accustomed darkness by feebly crawling in the direction of the nearest shadows. It is puffin-like in but one respect: it seldom protests vocally its discomfort.

When the eggs hatch in the various crevices, the events are quickly realized in the blind. The old birds begin to return from the sea with fish dangling from the sides of their mouths. One puffin does not arrive with *one* fish. One puffin customarily arrives with as many as six fish, frequently as many as seven or eight, occasionally as many as nine! And the fish are generally of the same size, usually herring fry.

How can a puffin catch fish in such quantities? In other words, how can it catch first one fish and, holding it, open its mouth to catch another without losing the one already captured? One would suppose that the first fish taken would be swept away by the water when the bird opens its mouth to grab a second

Continued on page 303

*Precocial birds are distinguished by the fact that their young are not hatched until able to care for themselves, as opposed to altricial birds.—Ed.



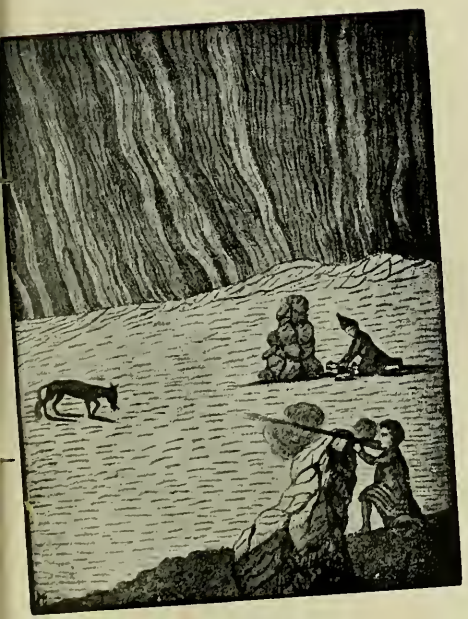
PUFFINS *catch as many as five or six herring fry at a time* (left). *Community life among the 1000 individuals on Machias Seal Island, near the Bay of Fundy, is active but, unlike other seabird colonies, it is almost silent. Puffin-Town does not as a rule express emotions vocally. The bird at right is probably yawning*

NORTHERN LIGHTS

By Clyde Fisher

Curator-in-Chief, Hayden Planetarium, and Curator of Astronomy
The American Museum of Natural History

The most beautiful spectacle of the night sky yields its secrets to scientific investigators



(Above) When the rays of the northern lights approach the magnetic zenith, they seem, on account of perspective, to converge at this point, and we see a so-called auroral corona. The magnetic zenith is about 15° south of the real zenith in the latitude of New York

(At left) An old drawing of Lapps hunting wolves by the light of the aurora borealis

From the dawn of history and without doubt from much earlier time soothsayers have sought to connect heavenly signs and wonders with human events. One of these celestial phenomena is the northern lights, before which primitive man has been held spellbound in so many different parts of the world, and into which he has read so many different meanings. The mind of the savage often seems to leap to a farfetched relation between the inexplicable happenings of the universe and his own daily life. But curiosity is the beginning of all knowledge. Could anything seem to stretch the imagination further than some of the things which now appear to be true? There is probably a relation, for instance, between spots on the face of the sun 93 million miles away and the spark that jumps when you gather electricity from the carpet and touch a doorknob. And the northern lights apparently provide a colorful background somewhere midway in the same chain of events.

G. K. Chesterton said, "Among all the strange things men have forgotten, the most universal lack of memory is that by which they have forgotten they

are living on a star." So should we be surprised that, when the sun chooses to "break out," our automatic telegraph machines spell out nonsensical messages, and even the *New Yorker* takes occasion to remark that it is an unusual season for "clothing electricity."

These and other happenings, including magnetic storms, seem to be intimately connected with those gigantic "whirlwinds" of erupting gas on the surface of the sun, which from this great distance appear as sunspots. But I intend to tell mostly of their most beautiful by-product, the aurora, a spectacle which may be viewed by many people who suppose themselves to reside too far south, and concerning which many interesting questions are raised.

Perhaps there was a foretaste of this abnormal season of related electrical phenomena in the most unusual and impressive display which some of us had the fortune to witness last summer on August 11th. Two miles south of the Canadian border on that date, on Lake Carmi, Vermont, the display was the most diversified and most beautiful I have ever seen—arches, streamers, curtains, and a gorgeous changing corona about the magnetic zenith, all with much color and movement.

On the following evening, August 12th, we had another fine display with extremely rapid, erratic movement. Patches of light with delicate green or red color would appear with the suddenness of heat lightning and disappear as quickly. An area of light would appear in the constellation of Cassiopeia, for example, and then apparently jump to the Big Dipper, or to some other region of the sky. It is probable that the display observed on the evening of the 11th continued all through the day of the 12th, but if so it was, of course, overwhelmed by the daylight.

There is evidence that the disturbance continued through the 13th. Professor Carl Störmer of Oslo, Norway, the world's leading authority on northern lights, wrote me that in Norway a strong magnetic storm (correlated with northern lights) was registered on the nights of August 11-12 and 12-13, and a smaller one on August 13-14. Overcast weather prevented him from seeing the aurora on the first night, but on the second he and other observers saw it in southern Norway. A magnetic storm should not be confused with an electrical storm with thunder and lightning. The former may occur in perfectly clear weather.

Later in the same month, on August 22nd, we were fortunate to observe a gorgeous display from Loon Island in Lake Winnepesaukee in the neighboring state of New Hampshire. In this we saw gradually develop in the northern sky a magnificent curtain or drapery with pastel colors of red and green, the largest and finest of this type in my experience. And on the following night, August 23rd, from the same place, we observed still another fine display. Four in one month!

For many years it has been known that displays of polar auroras—aurora borealis of northern latitudes and aurora australis of southern latitudes—were correlated with sunspot activity: the greater the sunspot activity the more abundant and the finer the displays of northern and southern lights. The phenomena of last summer proved to be further corroboration of this correlation.

Although the aurora baffles description in words, a few writers have tried to give us a pen picture of this gorgeous spectacle.

Bayard Taylor, in his *Northern Travel,* describes

AURORAL FORMS are classified according to their pattern, color, and movement. Following a major subdivision, the two on this page do not have ray structure, whereas those which follow do have ray structure. Below is an example of one of the simplest forms, the homogeneous quiet arc, often sharply defined at base, diffused at top

THE SECOND EXAMPLE without ray structure shown below is a homogeneous band. This form lacks the regular shape of the arc and moves more rapidly. It may have one or more folds as shown. These photographs, not ordinarily available to the public, are from the *Photographic Atlas of Auroral Forms,* compiled by the International Geodetic and Geophysical Union, Oslo

AURORA BOREALIS in Alberta, Canada: a painting by Leonard M. Davis, in the Hayden Planetarium

THE HOMOGENEOUS ARC *(extreme left)* can turn into an arc with ray structure, an example of which is shown below. The rays may be long or short

SIMILARLY, homogeneous bands may acquire ray structure, as shown below. The rays may be compact or scattered

vividly a display observed in Lapland: "We lay silent, with upturned faces, watching this wonderful spectacle. Suddenly the scattered lights ran together, as by common impulse, joined their bright ends, twisted them through each other, and fell in a broad, luminous curtain straight downward through the air until its fringed hem swung apparently but a few yards over our heads. This phenomena was so unexpected and startling, that for a moment I thought our faces would be touched by the skirts of the glorious auroral drapery. It did not follow the spheric curve of the firmament, but hung plumb from the zenith, falling, apparently, millions of leagues through the air, its folds gathered together among the stars and its embroidery of flame sweeping the earth and shedding a pale unearthly radiance over the wastes of snow. A moment afterwards and it was again drawn up, parted, waved its flambeaux and shot its lances hither and thither, advancing and retreating as before. Anything so strange, so capricious, so wonderful, so gloriously beautiful, I scarcely hope to see again."

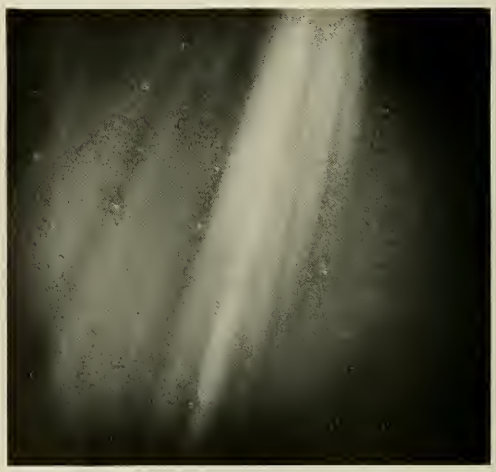
George Kennan, in *Tent Life in Siberia,* describes an unusually fine display, which occurred in the 1860's: "The whole universe seemed to be on fire. A broad arch of brilliant prismatic colors spanned the heavens from east to west like a gigantic rainbow, with a long fringe of crimson and yellow streamers stretching up from its convex edge to the very zenith. At short intervals of one or two seconds, wide, luminous bands, parallel with the arch, rose suddenly out of the northern horizon and swept with a swift, steady majesty across the whole heavens, like long breakers of phosphorescent light rolling in from some limitless ocean of space. . . . Never had I dreamed of such an aurora as *this*. . . . The whole sky, from zenith to horizon, was 'one molten mantling sea of color and fire, crimson and purple, and scarlet and green, and colors for which there are no words in language and no ideas in the mind,—things which can only be conceived while they are visible.'"

The northern lights of northern latitudes and the southern lights of southern latitudes are of various forms. At least a half-dozen types are of frequent occurrence, and there are many unusual forms. Perhaps the arch is the commonest type. Usually the displays of light are without color and without movement. But color is often present, usually in delicate pastel shades; the commonest colors are green and red, sometimes yellow and other colors, but very rarely blue. Movement is also frequent in these polar auroras, sometimes just a pulsating motion, but more often movement of greater magnitude, such as the shooting upward of rays or streamers resembling beams from searchlights, the climbing of arches and the waving or folding of curtains or draperies. Two of the most impressive displays, both with motion and color, are curtain types and the auroral corona which consists of streamers, often very broad, radiating from the magnetic zenith (about 15° south of the true zenith in the latitude of New York). The northern lights are usually seen in the north, but sometimes they cover all or nearly all of the sky, even down to the southern horizon.

The center of the belt of maximum auroral frequency is not near the north geographical pole, but in the vicinity of Smith Sound at the northwestern corner of Greenland, which has for convenience been called the north auroral pole. The belt of maximum frequency is nearly circular and is about 23° from the north auroral pole.

It is somewhat surprising to find that a large proportion of the people of the latitude of the United States have never seen the northern lights. It is rather generally believed that the northern lights cannot be seen south of, let us say, the latitude of New York City, but this is also an incorrect notion. The display of January 25-26, 1938, was observed as far south as Palm Beach, Florida. This magnificent aurora, it will be remembered, was visible practically all over

Draperies: If the rays become very long, the band appears like a curtain or drapery, whose lower border is often more luminous. Near the zenith the form may be fanlike



Great masses of rays bunched together are called "ray bundles." The photographic exposure varies from ½ to 60 seconds, depending on intensity and stability

Europe, as far south as Gibraltar and even over into northern Africa a little way. A number of displays have been reported from New Orleans by an enthusiastic student of these phenomena. It should be stated, however, that most of these were probably not conspicuous enough to attract the attention of the layman.

It is rather generally believed that the displays usually, if not always, occur in the winter, but this is a mistaken notion. It is no doubt true that relatively more displays are seen in this country during the winter than during the summer months, but this is only because the winter nights are longer.

To summarize the answers to the questions so frequently asked, one may correctly state that the northern lights may be seen at any time of year, at any time of night, anywhere in the United States, and that the displays are correlated with sunspot activity.

Northern lights do vary with the latitude. The displays average much better in the latitude of Cincinnati than in that of New Orleans; much better in the latitude of Toronto than in that of Cincinnati; and much better still in the latitude of Hudson Bay. It was formerly thought that they would continue to be better until one reached the north pole, but it has been found that the area of maximum auroral activity is a zone surrounding the north auroral pole, mentioned above, and roughly about as far from it as the Arctic Circle is from the north geographical pole.

Certainly one of the most common questions asked about the polar auroras is, "What causes them?" A generation or two ago they were popularly believed to be produced by the reflection of sunlight on the ice and snow of the polar regions. It is now known that they are caused by streams of electrons shot out from the sun, which are more abundant at times of great sunspot activity. These electrified particles strike the upper regions of the air where the gases are extremely rare, producing effects similar to those caused by electrical discharges in neon signs or in the Geissler tubes of our physical laboratories.

The spectrum of the aurora shows bright lines, the brightest of which in the green is due to the excitation of oxygen. The red color is produced by the excitation of nitrogen. All the color is produced in the upper atmosphere. In fact we get our most delicate tests for the height of the earth's atmosphere from the northern lights, the greatest height measured by Professor Störmer being 1000 kilometers (about 620 miles), and the lowest 80 kilometers (about 50 miles). In spite of the fact that some explorers and travelers in the north have reported seeing the aurora reach down to the earth, there is no instrumental evidence to support this.

The method of measuring the height of the aurora, and therefore the height of the atmosphere, was developed by Professor Störmer with a special camera which he devised for the purpose. To carry out the project, two observers are necessary, each with a camera, located at separate stations, the distance between which is known. Professor Störmer's base lines between his stations range from about 12 to 185 miles. By direct telephone communication the photographs may be made at the same instant. The cameras, which are exactly alike in optical equipment and in emulsion of the plates, are pointed in the same direction, determined by certain stars, and the exposures made. When the plates are developed they show a shift of the aurora against the stars beyond, which the astronomers call parallax, and this provides the necessary data for computing the height of the aurora, as well as the height of the lower limits of the aurora above the earth, and the distance of the aurora from the observers. The calculation is based on trigonometry, for we have two angles and the included side of a triangle. Although two stations are all that are absolutely necessary, Professor Störmer sometimes refines the experiment by having photographs made simultaneously from three or even four separate stations.

One of the mysteries of the northern lights, still unsolved, is the phenomenon of sound accompanying certain auroral displays. Many observers familiar with northern lights have never heard the sound, and naturally they are incredulous. But now there seems to be very little doubt that sound correlated with the aurora does sometimes occur. But it may not be caused by the aurora; both may have a common cause. The sound has been described as hissing, crackling, rushing, or rustling—similar to that of the rustling of the leaves of a tree in a breeze, or to that of burning grass. On account of the great height of the aurora, says Professor Störmer, it is clear that the sound could not come from the aurora itself, but from lower parts of the asmosphere. Its origin is still to be explained by future observations.

Although the northern lights cannot be seen in the daytime, since their delicate light is overwhelmed by the light of the sun, it is a very interesting fact that the rays which extend high above the earth are occasionally seen in the sunlit part of the atmosphere, usually soon after sunset or shortly before sunrise. Professor Störmer states that since his permanent auroral stations in southern Norway were established in 1911, sunlit auroral rays have been observed and measured about 50 times. On two occasions these sunlit rays were blue. "On the night of April 18-19, 1939," he writes, "very high rays occurred in the sunlit part of the atmosphere over northern Sweden, which in spite of their great distance, about 900 kilometers [560 miles] from Oslo, were visible because of their enormous height."

While we do not yet thoroughly understand the northern lights, they are slowly giving up their secrets. We know that the light is produced at great heights in the earth's atmosphere; that it is due to excitation of the gases of the atmosphere by electrified particles that come from the sun; that the rays or streamers, when they occur, are parallel to the earth's lines of magnetic force; that the green color is due to oxygen and the red color to nitrogen; that magnetic storms (disturbances in the earth's magnetic field) always accompany an aurora; that the finest and most frequent displays occur during maximum sunspot activity.

But pushing back the frontiers of our knowledge will not destroy any of the beauty or impressiveness of this phenomenon, which, when seen at its grandest, may be likened in its emotional effect to one's first view of the Grand Canyon of the Colorado—overwhelming and altogether incredible.

THE ODYSSEY *of* UNCLE SAM'S EAGLE

By LUCY EMBURY

Courtesy of The Metropolitan Museum of Art

Eagle-headed winged being, pollinating the sacred tree—Assyrian, ninth century, B. C.

Unfurling 5000 years of history behind his wings, his feathers shimmering with an ancient iridescence, the "King of Birds" has flown to perch upon our national emblems

All drawings by NATALIE HARLAN DAVIS

UNCLE SAM'S bird belongs to a splendid and widespread family, rulers of the sky and of man's imagination since the dawn of time. For centuries past, countless eagles have sat upon banners of chiefs and coins of kings the world over. Fully 5000 years of history unfurl behind their wings!

But our Continental Congress of 1776 did not stop to think of this when they hastily appointed a committee to select some symbol for the seal of the newly born United States of America, some charm to hang about the neck of the baby nation. Indeed, Congress could not then have known the eagle's long odyssey nor followed his emblematic flight over centuries and seas, for ornithology and archaeology—those fruitful sciences of birds and beginnings—were, like the United States Republic, still in swaddling clothes. King Tutankhamen still slept calmly in his tomb, and the Mesopotamian cities lay dreaming under desert sands. No one knew much about the Pharaohs in troublous '76, nor cared that they didn't. Life was busy with the building of a fresh civilization. Ur and Nineveh meant nothing to our liberty-loving colonials. It was not Darius of Persia but George of England against whom we were girding our loins. What could Egypt or Sumer matter while angry red men were shooting arrows into our backs and angry redcoats puffing smoke into our faces?

Sumerian lion-headed eagle—2950 B. C.

The place of birds in the economic cycle was an unknown quantity, and harassed pioneers had no spare hours to spend upon beauty. Bird portraiture would have seemed a fantastic and futile waste of eye and muscle when every sound finger was needed for flintlock, every strong fist for axe and spade. Luckily for his life's work, not for four years would Audubon open his eyes to the light of earth in Haiti—a Frenchman born on soil still French, destined to become the great recorder of America's birds.

In the "little red school houses" of the thirteen States, bird study did not jostle elbows with the three R's, and the word "ornithology" lay undusted between dictionary covers. Even well-informed Benjamin Franklin, Thomas Jefferson, and John Adams, all serving on the Congressional Committee probably never used it. The eagle in Nature, of course, they knew, especially that lordly white-headed bird which haunted river cliffs and ocean coasts. An indomitable, powerful, long-lived sky creature that soared across the sun!

Yes, as an emblem the eagle would answer. So the three agreed and, with a breath of relief, turned to more pressing problems. The thirteen Colonies were small and young, and clung precariously to a narrow strip of open coast, menaced by wide reaches of unknown hinterland and a frontal enemy. The demands for statesmanship were many. Men's gaze and strength were set upon the morrow. To yesterday they gave no thought.

But out of a faraway yesterday Uncle Sam's eagle had flown to perch upon our flag. His feathers shimmer with an ancient iridescence. He reigns by right

of innate strength and time-honored heritage. His shadow falls upon the hills of Asia and upon the African plains, flits over European forests and the Australian bush, casts its royal purple on the two Americas. Nature, with munificent hand, placed the eagle everywhere!

Thousands of years ago untutored men tilted back their heads, stood staring upward. The great bird soaring there above them on tireless wings, so high, so remote touched them with awe; his power must be other and vaster than their own. His eye pierced long reaches of space, detecting from afar slow-moving sheep upon the plain or antelope fleeting through fringes of forest. Like a thunderbolt he flashed down, bore an impotent beast aloft between his talons for some feast in which mortals never had a share. He feared not lightning, nor storm; for hours he floated on tempest. His home was on lofty places, none knew where. He circled the crest of Parnassus, of Olympus; he dove down ravines of the Hindu Kush. He did not die, it seemed, this God of Air, Spirit of Sky. The Greeks called him "Messenger of Zeus," logically enough, since the very word "Zeus" is derived from an ancient word signifying "sky."

The eagle is a royal bird and plays a dramatic role in Nature. Small wonder that from the beginning he has gripped the minds of men! The eagles are widely distributed over the earth. Their names are charged with romance, their lives with curious aloofness. The golden eagle of the north temperate zone is said to live a century and often nests in an eyrie built on cliffs almost inaccessible to human feet. The imperial eagle seeks out the tallest trees of Europe.

Naturally enough, then, eagles of one kind or another came in very early days to be associated with the lordliest rulers in history. Those first kings won and held their kingship by superior prowess or wit, not because of precedent. They had the fearlessness and strength of eagles. So primitive peoples set the Spirit of Sky upon the banners of their chiefs and endowed both with qualities divine. And, not content with that, wanting always to add more power, they conceived a double-headed bird, facing east and west, god of dawn and sunset, master of yesterday and of tomorrow, like the later Roman god, Janus. Fancy brought into being, too, the griffin, part eagle, part lion, yet a creature curiously real, a symbol of vigilance.

The two-headed eagle was flaunted by Belshazzar of Babylon in the sixth century B.C.; and Sennacherib the Assyrian (705-681 B.C.) had a griffin engraved upon his shield. In fact, both emblems were used far earlier, about 3000 B.C., on arms and trophies of the Sumerian city kingdom of Lagash. When, in the time of Sargon and even before, the hawk-nosed Hittites came sweeping down from northern hills into the "Land of the Two Rivers" and surged through the valley of the Tigris and Euphrates where lay Babylonia, they found and bore off with them its ancient embems, which in later wars of conquest were taken across the Aegean and up into Europe.

The peoples of ancient Asia Minor had a natural flair for decorative art, a singular facility for catching the character of animals, rendering them in simple planes and trenchant strokes. They knew Nature, lived close to beasts, birds, and trees; their thought was uncluttered by canons of procedure. By instinct they worked in an emblematic way, bequeathing many a motif to medieval heraldry. With a few bold lines the hauteur and invincibility of the eagle were depicted. Austria, Germany, Rumania, Poland, Bolivia, Chile, Colombia, Ecuador, Panama, South Australia, and the United States, still echo on their banners the artistry of early Mesopotamia.

It was Rome that carried the bird of victory northward into France. Half a century before the birth of Christ, Caesar's legions attacked the Parisians in their citadel upon the Ile de la Cité, then a wild island, now the heart of Paris. No doubt those uncouth islanders—a little tribe among the many tribes of Gaul—looked with envious wonder at the swarthy soldiers from the south bearing standards with golden or silver eagles. Superstitious soldiery they were, who pitched winter quarters wherever they could find an eagle's nest, because it was a bird of such good omen! They built a road across the Ile de la Cité, across the square now spoken of as Parvis de Notre-Dame, and on the very site of the Cathedral itself an altar to Jupiter stood till after the fourth century. The Romans loved their eagle; Aquila, they called it, and named the north wind "Aquilo" because it came swooping with resistless speed. On gala occasions when an emperor rode through the streets of Rome in triumph, purple-clad and swaying upon a chariot drawn by laurel-decked steeds, Jove's bird was part of the imperial paraphernalia. In his left fist the victor grasped an ivory scepter topped by an eagle fashioned of precious metal, which blazed in the sun as the stately procession passed, dazzling the sight, greeted by the thunder of a wildly cheering throng.

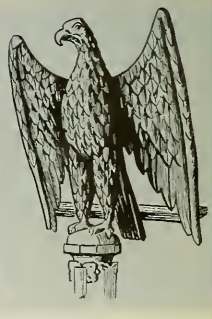
Gradually, the great bird gave its name to a number of things—oddly incongruous things. Gamblers around the roulette wheel nervously watch the eagle bird whereon they may have staked their all. Stargazers get a thrill watching that beautiful northern constellation known as Aquila, which rides the Milky Way. Artificers in brass create superb lecterns; the Scriptures rest on outspread wings, and such churchly reading-stands are spoken of as "eagles." Architects apply the term to Greek temple pediments; bankers apply it to $10 gold pieces. In the Middle Ages outstanding men, whether of war or peace, were likened to Zeus's messenger. The famous Dominican, Thomas Aquinas, was dubbed by believers the "Eagle of Divines"; Bossuet of surpassing eloquence was hailed as the "Eagle of Meaux"; and daring Bertrand Du Guesclin was acclaimed the "Eagle of Brittany."

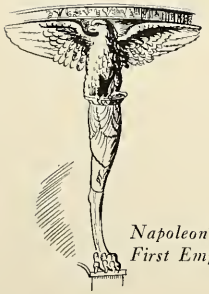
France, under her emperors, used the eagle, even as under her kings she used the fleur-de-lis, which it antedates as a French royal badge. Invited by the Pope to head the Holy Roman Empire, Charlemagne was crowned by Leo III in 800 A.D. and thus inherited the ancient emblem of the Caesars. Later, when Otto the Great succeeded to the title in 962, the imperial eagle passed over into Germany and became a feature of Teutonic heraldry. Emperor Henry III (1039-1056) surmounted the scepter on his seal with an eagle, and in the twelfth century the bird was embroidered upon the royal gloves. Not till after 1414 A.D., however, did a double-headed eagle appear as a fixed device upon the arms of the Holy Roman Emperors.

Eagle of Roman Empire—second century after Christ

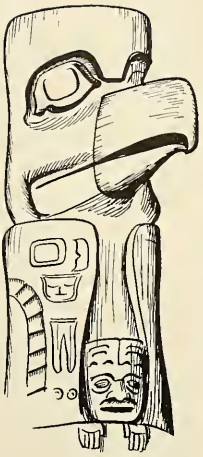
Charlemagne's armorial eagle, used on the trappings of his horse

Eagle lectern, French, late fifteenth century

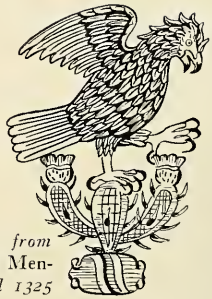




Napoleon's eagle, First Empire



Totem pole eagle of the Haida Indians



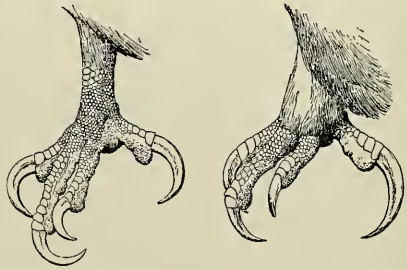
Aztec eagle from the Codex Mendosa, *around 1325*

Inevitably, through succeeding centuries a bird of such natural splendor and rich traditions was adapted to countless decorative uses. But in France it did not again become a major motif until the "Little Corporal" dusted off the throne and set himself upon it. Then, almost overnight, at Napoleon's behest, the Empire Style was created with its sharp revival of classical themes. Gilded eagles were everywhere, companioned by Egyptian sphinxes and Athenian bees. The fashion influenced both England and her freed colonies overseas. Young America was bound by ties of gratitude and sympathy to elder France. Besides, the eagle was already the new nation's emblem. So Aaron Willard put the bird atop his banjo clock and Duncan Phyfe thus embellished fine, formal furniture for the increasingly luxurious homes.

Yet it was not the white man who introduced the eagle to the West. Long before his coming the "thunder bird" had captured the souls of red men even as it had caught the fancy of the early Assyrian and Greek. The Alaskans carved it on their totem poles, the Aztecs on their palaces. When, in 1519, Cortez marched upon Mexico City he met warriors "bearing the golden eagle with outspread wings, in the fashion of a Roman signum, richly ornamented with emeralds and silverwork, the great standard of the Republic of Tlaxcala." Three hundred years before Bonaparte put it on the leg of a console, an eagle ornamented Montezuma's lintel! Indeed, the even earlier Toltec bird sired Mexico's present coat of arms.

Native to the Western Hemisphere are several eagles, among them the harpy eagle chosen by the Mexicans for their national shield, and the bald eagle which distinguishes Uncle Sam's flags and coins. Incidentally, the bird isn't bald at all, but when adult its head and neck are feathered with white, conveying from a little distance an effect of baldness—hence the unattractive and really untrue name. The bald eagle is an impressive creature, nevertheless, and lord of air all the way from Alaska to Mexico. Hendrik Hudson must have seen it soar as, in 1609, he plied upstream, for the bird has ever haunted the high banks of the river. Of course, other explorers and the colonists must have seen it too, noticing its bare shanks, unlike those in their European homelands which were feathered to the toes.

French and Dutch, Spaniard and Briton, knew the bird in heraldry also, and among those early settlers were some whose lineage entitled them to bear it upon signet and shield. For instance, the family crest of the Washingtons of Sulgrave carried an eagle dating



FOOT OF BALD EAGLE FOOT OF GOLDEN EAGLE

At any age the golden eagle may be distinguished from the bald eagle by its fully feathered tarsi, or shanks (From Frank M. Chapman's Birds of Eastern North America)

from at least 1588. Curiosity on this score can be satisfied by a visit to Fawsley Church, Northants, where the crest now hangs, having been removed there from the Manor. Naturally enough, then, when the new republic began to search for a suitable badge, the fine, familiar emblem came immediately to mind. The story of its adoption is interesting, likewise amusing.

As we already know, the Continental Congress in 1776 appointed Benjamin Franklin, Thomas Jefferson, and John Adams as a committee "to prepare a device for a Seal of the United States of North America." After duly putting their heads together for several weeks, these illustrious statesmen reported back to Congress on August 10th, suggesting "E Pluribus Unum" as a national motto. A happy choice, the Congressmen thought, a phrase that everybody knew—even those who didn't bother about Latin. For everyone read the *Gentleman's Magazine* and "E Pluribus Unum" was the magazine's motto—in consequence a "most appropriate description of the new order of things." Franklin, the master publicist, well knew the value of familiar phrases!

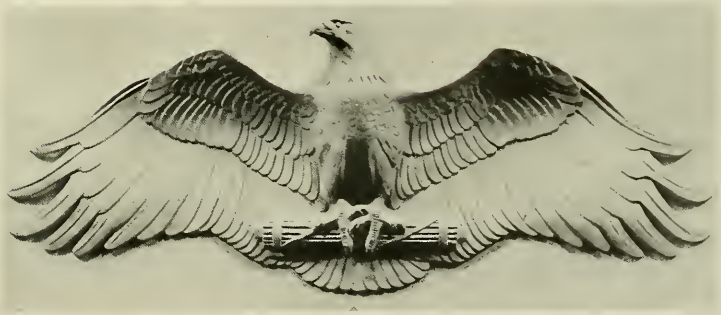
However, during subsequent discussion, Franklin strongly objected to the selection of a bald eagle as the national symbol on the grounds that it was a bird of bad moral character, which does not get his living honestly. The eagle does, to be sure, plunder fish from the osprey and in general lives by seizure. Nevertheless, in the end tradition outtopped protest, and by Act of Congress, June 20th, 1782, the time-honored bird was finally and officially placed upon the seal of the United States—with an olive branch in his dexter talon.

Meanwhile in 1778 New York State had set an eagle upon its arms and flag, which flew in triumph above Colonel Peter Gansevoort's Third New York Regiment at Yorktown when Cornwallis' surrender led to the freedom of the Colonies. By Act of March 2nd, 1799, the bird was adopted for the Revenue Ensign. Today it is associated also with the President's flag; with the Congressional Medal, the highest United States Government award; with the Navy Medal of Honor; the Distinguished Service Medal and Distinguished Service Cross, established by Executive Order in 1918 and designed by Major Aymar Embury II; as well as with divers lesser insignia.

When on May 10th, 1783, the Society of the Cincinnati came into being, once again the symbolic eagle—so rich in immemorial meaning—was chosen. Valorous young Pierre Charles L'Enfant designed the insigne for this group of his comrades-at-arms, Colonial and French, who sought to prolong and cement friendship by some perpetual link.

Appropriately, the eagle of Lagash, bequeathed to Charlemagne, spread his wing tips to touch two shores: the shore of a young land loved and served by Lafayette and by many sons of France, and the shore of France herself. A badge was but a toy to the brain of Pierre Charles L'Enfant, a brain capable of large as well as little beauty. So in 1791 he planned the city of Washington, charted out the gracious space of America's capital—a greater and more lasting service than that of his ready sword.

So the next time you take a quarter out of your pocket it may be interesting to remember that as early as 1787 the United States eagle ornamented Massachusetts half cents and the pennies of New York State. And when you next glance into your "Constitution mirror," it may be amusing to recall that countless centuries ago fair queens of Babylon smiled into polished metal mirrors beneath the eye and aegis of a sage old bird.



(Above) MODEL *of a new realistic bald eagle recently selected to replace the heraldic eagle on certain historic markers by the National Park Service of the United States Department of the Interior*

Lombordi photos

FAMED *as the spot where Ulysses became the guest of the enchantress Circe, the promontory of Mount Circeo is the scene of the Old Stone Age burial described in this article*

IT WILL be recalled that in the prehistoric past, when the world had not yet survived the Ice Age, people whom we know as the Neanderthal race lived for many thousands of years over much of central and western Europe.

These Neanderthal people are important because they are the oldest race to leave such abundant archaeological evidence. Proof of their existence has been found in a variety of flint implements covering a wide area, which show a definite advance over the crude handiwork of their predecessors. They knew the use of fire, but had not invented anything as complicated as pottery or basketwork.

Speaking in general terms, the typical Neanderthal man was a powerful person with large chest and thick-set bones. His forehead was lower than ours, with heavy eyebrow ridges, yet he was clearly human. He was shorter than the average European of today but walked as erect.

Sometime during the Ice Age, these people apparently disappeared in Europe and soon various other peoples appeared on the scene, among them the artistic Cro-Magnon race, who distinguished themselves by artistic cave paintings. They exceeded modern man in stature.

The Neanderthal discovery I am about to relate is interesting because it sheds additional light on the life of the Neanderthal people. Furthermore, the often difficult problem of dating ancient human remains is in this case clarified by a nicely linked chain of evidence permitting a reconstruction of the climatic and geographical conditions under which they lived.

The scene of our discovery was a cave in Mount Circeo where, according to the Homeric poem, Ulysses landed on a stormy night to become the guest of the enchantress Circe. This is in the section south of Rome known as the Pontine Plain.

The archaeologist follows a variety of clues in his search for the proverbial "needle in the haystack." In 1929 a Neanderthal skull had been found in a gravel pit in Saccopastore, a suburb of Rome, and in 1935 the celebrated archaeologist Abbé Breuil and I were fortunate enough to find a second one in the same location. Abundant prehistoric remains were also found in various places on the Pontine Plain, indicating that ancient man had flourished in this part of Italy in the course of the Ice Age, tempting further search with the most encouraging promises. Conse-

THE FOSSIL MAN OF CIRCE'S MOUNTAIN

By ALBERT CHARLES BLANC
Professor of Human Palaeontology, Royal University, Rome, Italy

A "murder story" of 70,000 years ago unfolds when the scientific detective interprets clues left at the cave burial of a Neanderthal man, whose mourners mutilated the remains yet were apparently stirred by spiritual sentiments

CLOSER TO THE SEA *than the burial cave, many of the shore grottos also were inhabited by Old Stone Age people during the last Ice Age when the sea was some 300 feet lower*

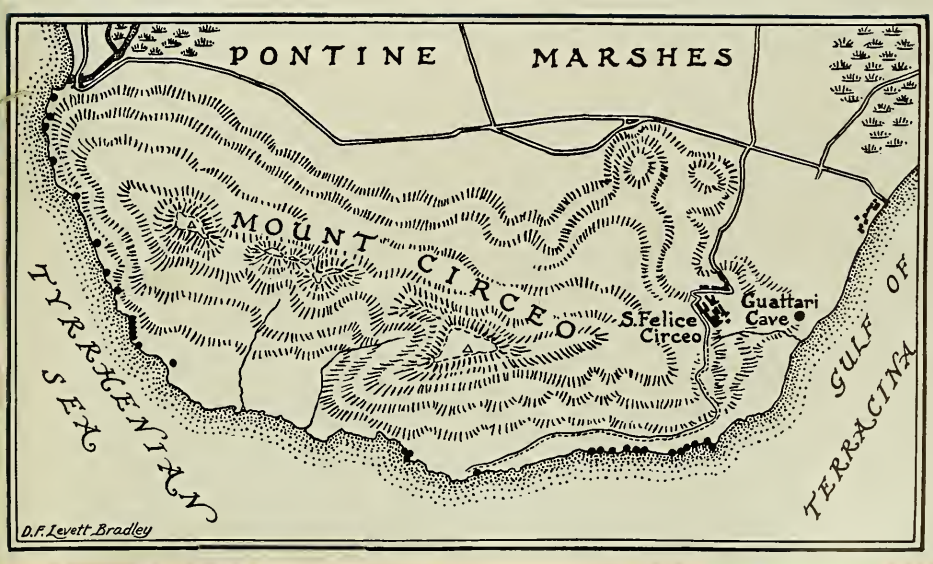
quently I decided to explore the coastal caves of Mount Circeo in 1935.

The south face of this limestone mountain descends deeply into the Mediterranean Sea. Four caves were already known, and I numbered 27 more. On preliminary search ten of these yielded remains of extinct animals and traces of human industry belonging to the Old Stone Age. We were on a scent that was to prove rewarding beyond our expectations.

One day while I was at the house of Signor Guattari, proprietor of a charming little hotel at the foot of the village of San Felice Circeo, he showed me some ancient animal bones that his workmen had found while quarrying below the hotel. Some of the bones showed the telltale marks of having been broken, and it was a fairly safe deduction that Paleolithic man had fed on the flesh.

I urged Signor Guattari to keep on the lookout and to have his workmen save anything they found. When next I visited him, he surprised me by producing two full boxes of fossil animal bones. I repeated my advice, adding that he might find an extremely rare and precious fossil, a Neanderthal man, for example. I scarcely dreamed what a good prophet I was to be.

It was in a cave appropriately named Grotta Guattari, after its owner, that the unusual discovery of this



HISTORIC *Circe's Mountain overlooks the sea 56 miles southeast of Rome, as indicated at far left. No fewer than 32 caves have been discovered on this promontory, many of which have yielded traces of human industry belonging to the Old Stone Age and the remains of extinct animals. The caves are represented by heavy dots. The cave where the Neanderthal man had been buried is named Guattari Cave*

Blanc photo

WHEN *Signor Guattari's quarrymen found ancient bones that had been broken* (above), *Dr. Blanc urged vigilance, boldly prophesying they might find a Neanderthal man*

ancient man was made. The entrance was through a very narrow opening, and for about eight yards we had to grope our way on all fours. Then the way opened into a chamber where the floor, approximately four by five yards, was literally covered with fossil bones. Antlers and skulls of various animals were mixed with stones that had fallen from the ceiling. Some of the bones were cemented to the ground by stalagmitic deposits, but many were loose, only their surfaces being covered with a strange, pearl-like concretion. We knew that we had entered upon a very ancient scene. In a corner, half-covered by a small pond, lay remains of an elephant and a hyena, as well as of wild oxen and deer.

The real excitement came in a third chamber, or crypt. Lying in the middle of some stones placed in the form of a rough oval, rested this Neanderthal skull, perfectly loose on the ground. Bones of oxen and deer lay scattered in several corners. The human skull and the other bones (none of which were human, except a jaw piece) were all covered with the pearl-like deposit.

The evidence allows us to piece together a reasonably definite story of what happened here. The man had probably been killed by a blow in the region of the right temple and eye, which caused a fracture, visible in the photograph on page 284. Thereafter he had been beheaded, outside of the cave, no trace of his skeleton having been found. The circle of stones suggests that his skull was laid to rest with ceremony, and we may assume that the rites were performed by his own people rather than a different race, for the industry that has been found in the cave is exclusively characteristic of the Neanderthal people.

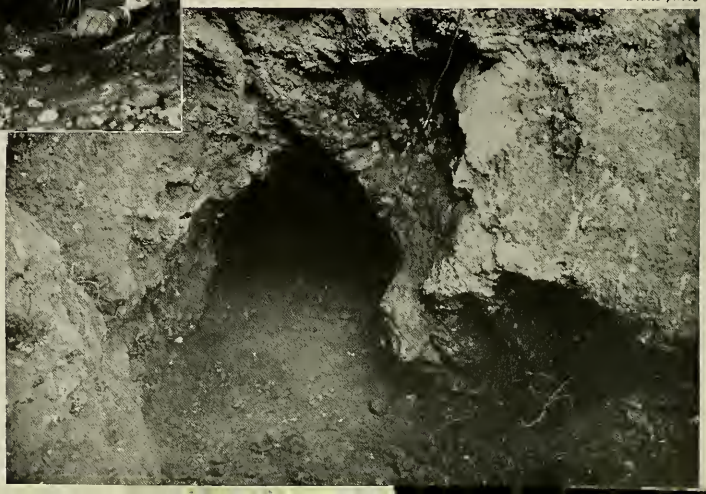
Strangest perhaps of all, however, is that the skull shows signs of mutilation after death in the form of a symmetrical opening at the base. This suggests that the people were given to the practice of removing the brain as part of the death ceremony, possibly also to ceremonial cannibalism. As Professor Sergio Sergi, anthropologist at the Royal University, Rome, has

Carmassi photo

FALLEN MATERIAL *had stopped up the entrance to the cave not long after the primitive hunters had laid their companion to rest in it. At right is shown the opening of the cave at the beginning of excavation work*

(Left) THROUGH *the narrow entrance to the cave, one had to creep on all fours for about eight yards. In the 70,000 years or more since the Neanderthal man was ceremoniously interred here, no one had previously entered*

Blanc photo



pointed out, mutilations of similar size and shape for the extraction of the brain are to be seen on Melanesian skulls from the Pacific in recent times in the collections of the Anthropological Institute of Rome.* Ceremonial cannibalism, if that is to be considered in this case, is practised by many primitive people of today, who eat a small portion of the heart, liver or other organ of the dead to acquire his virtues or propitiate his ghost. In any case this ancient burial shows concrete evidence of spiritual beliefs. Its circle of stones and the removal of the brain signify that these Neanderthal people of the Ice Age believed that the remains of the dead must be accorded certain ceremonies for what we might call religious reasons. The practice of death rites almost certainly implies the belief that the spirit does not end with death, so perhaps this is the earliest evidence of man's conviction in the survival of the soul.

Professor Sergio Sergi has concluded from a close study of the skull that this individual was a man of about 40 or 50, who had, however, lost his teeth before death. This is evident because the alveolar processes, in which the teeth are set, had completely atrophied.

This skull, with a capacity of 1550 cubic centimeters, is actually larger than the average among our own races today. However, we must not jump to the conclusion that the human race is on the decline, for as we know from present-day studies, the size of the brain is no indication of mental capacity. As Professor Sergio Sergi points out, the skull of Mount Circeo is exceedingly low in the forehead region (basilo-bregmatic height)—lower, in fact, than any other Neanderthal skull of such large size. The face was very large, and so were the eyes and the nose. The nose is

* It is interesting that Peking Man, living many thousands of years earlier and in another part of the world, is discovered to have mutilated the skull at the base in a similar fashion. ("Did Sinanthropus Practise Cannibalism?" by Franz Weidenreich, the fourth of six lectures on Sinanthropus and related problems: *Bulletin of the Geological Society of China*, 1939, Vol. XIX, p. 56.)

Cormassi photo

IN *the first chamber, "the floor was literally covered with fossil bones . . . a very ancient scene"*

Cormassi photo

SOME OF THE BONES *were cemented to the ground, others loose, covered with a pearl-like concretion*

(Right) REAL EXCITEMENT *came in the inner chamber, or crypt. In the middle of some stones placed in the form of a rough oval rested the Neanderthal skull. Bones of oxen and deer lay in several corners*

Blanc photos

(Left) THE OVAL *after removal of the skull. Signs indicated a ceremonious burial*

the highest and largest among all the Neanderthalian skulls whose dimensions we know.

The incomplete human jaw piece referred to above is almost entirely covered with a hard and thick calcareous deposit, which makes its preparation difficult. From what can be seen at present, the left branch is entirely destroyed, but the piece is very strong and reminds us of the general Neanderthal type.

Neanderthal Man was a human species that became extinct. Professor Sergio Sergi's conclusion, based on extensive study of the architecture of this and other skulls from the Ice Age, leads to a distinction of at least two different varieties of Neanderthal Man. A sufficient number of skulls from the Middle Ice Age, or Middle Pleistocene period, has been found to distinguish the Neanderthal type from other people living at about the same time. The skull of Mount Circeo belongs among the true Neanderthal skulls, with characteristically large capacity and other features which are almost invariably present. The similarity of all these skulls is more marked, indeed, than is to be seen in numerous series of modern skulls belonging to the same race.

The skulls with which the Man of Mount Circeo belongs represent the end branch of a race, as remarked above, which was extinguished during the last glaciation. This happened, according to Professor Sergio Sergi, because their anatomical adaptability decreased until their evolution reached such a stage of extreme fixity as to mark the end of the species.

Few other fossil men can be so well dated as this Man of Circe's Mountain. To fit him into his proper place in time, let us follow the marked climatic and geographical changes that took place during the Ice Age. It is to be recalled that great glaciers descended upon North America and northern Europe in a series of advances and retreats, which radically modified the climate over a period of many, many thousands of

Sergio Sergi photo

(Left) THE FOSSIL MAN of Circe's Mountain is estimated on reliable scientific evidence to be between 70,000 and 130,000 years old. Evidence of the fierce blow that is believed to have killed this man is seen in the region of the right temple

He is identified as a member of the Neanderthal race, which lived for many thousands of years over much of central and western Europe in the Ice Age. This individual was a man of about 40 or 50, and his skull, though low in the forehead, had greater cubic content than the average of existing races

(Left) STONE implements from same cave. Industry of this type, named Pontinian after the neighboring Pontine Plain, resembles Mousterian industry from Castillo Cave, Spain

Vasari ph

years. These glacial attacks, of which there were at least four, affected the level of the oceans of the world. Though the reader may not have thought of this, it is an altogether natural effect, because the glaciers took so much water from the sea and stored it above the surface of the land that the level was necessarily lowered.

With the melting of the glaciers each time, the sea again rose. Indeed, in the interval between the last two glacial advances the level of the Mediterranean Sea rose higher than it is today. The beaches that it left at this time along the Italian coast have been examined and found to stand from 16 to 65 or more feet above the present water level.

The geological name for this body of water which overlapped the present Mediterranean between the last two glacial advances is the Tyrrhenian transgression. Its water brought into the Mediterranean region an assortment of marine creatures which have

Sergio Sergi photo

(Above) MUTILATION after death. The opening in the skull's base suggests brain removal as part of death ceremony, possibly also ceremonial cannibalism. Identical mutilations occur in much older Peking man and recent skulls from the Pacific

THE GEOLOGIC STORY. Ancient shore lines prove that the level of the Mediterranean was higher than today during the period between the last two glacial advances of the Ice Age. Top drawing shows a typical cave on the shore of Circe's Mountain flooded at that time.

The accumulating ice masses of the last glacial advance took water from the sea, causing its level to drop. The shore caves were exposed, and men of the Old Stone Age occupied them. Thereafter, fallen rock and windblown deposits partly or wholly filled the caves *(second drawing)*.

Melting of the continental ice sheets again raised the sea level. Action of wave and weather removed part of the debris from the caves *(third drawing)*.

(Bottom drawing) The cave where the fossil man was found. Its story was the same during the first two stages, but being a short distance inland, the sea never removed the debris hiding its opening

Drawings by John C. Germann

since disappeared from this area. Today some of these animals are still found in the Atlantic waters off the coast of Morocco and Senegal.

Exploration of the 31 caves of Circe's Mountain shows that this Tyrrhenian transgression had penetrated them. The climate in Italy at this time was probably hot, and hippopotamuses, elephants and rhinoceroses roamed the country.

With the advance of the last glacier over northern Europe from the north, the Tyrrhenian Sea shrank, leaving the beaches referred to above. One of these beaches was fortunately left in such a position at the base of the filling of this cave on Circe's Mountain that we can say with certainty that when the sea stood at this level the human remains we found had not yet been placed in the cave. So much for the maximum limit. It was not long after the retreat of this sea that our Neanderthal people visited the cave. The minimum limit is fixed with equal certainty.

It was near the beginning of the last glacial advance that our primitive hunters interred their companion. The climate was growing cooler, but the warm pachyderms were still persisting on the coastal plain. Not long after the retreat of the Tyrrhenian Sea, the entrance of this cave was stopped up by fallen material, preventing man's entrance, and Europe was in the throes of the last glacial climatic crisis. Thus we have the time of the fossil man of Circe's Mountain fixed between much more narrow limits than is usually possible in a discovery of this sort.

The casual reader may still wonder where, in terms of years, this man is to be placed. It is even possible to determine this within certain limits. Probably the most reliable "yardstick" of geological time is that which uses the known rate of solar radiation received by the earth in relation to the changes in its astronomical position. If one applies the radiation curve of Milankovitch to this problem, one gets a maximum age of 130,000 years for this Neanderthal man and a minimum of 70,000 years. The frequency of a goat-like animal known as *Catra ibex* on the surface of the ground in the cave indicates that the climate had already become cold, and therefore the age of 70,000 years probably comes closer to the correct one for the fossil man of Circe's Mountain.

The world was to witness considerable changes in the centuries that followed. The cold and dampness increased with the advance of the ice, and the level of the ocean and all open seas sank over 300 feet below their present level. Big coastal plains, which are now a part of the underwater shelf, emerged, and were inhabited by animals and men. Islands now again isolated, like England, were connected with the continent, and plants and animals spread over land bridges from one continent to another. From a vegetation similar to that which grows at present on the Mediterranean shores, we see the Pontine lowlands invaded by a cone-bearing tree which today is restricted in Italy's Apennines to elevations over 2900 feet.

Many generations of man came and went. The plain around Circe's Mountain and some of the other caves were inhabited by the so-called Aurignacians, who may have been contemporary in their latter days with the Cro-Magnons, whose artistic paintings and engravings in the caves of Spain, France and Italy have attracted so much interest. But no one down to our own time ever entered the cave where this Neanderthal man was found, for its opening was already closed and hidden when the next people came—its contents, indeed, probably already fossilized.

Unlike many caves, its floor had not been piled high with material from the ceiling. Filling of this sort had stopped suddenly and completely with its closing up. The interior has, therefore, maintained for us, throughout the ages, a striking vision out of the Old Stone Age, a tableau such as one has never witnessed before. In the uncanny corners we see where hyenas and men alternately sought safety; and on the floor, amid broken bones and antlers scattered everywhere, lay the human inhabitant himself, the fossil Neanderthal Man, waiting for us through the eons in his mysterious circle of stones.

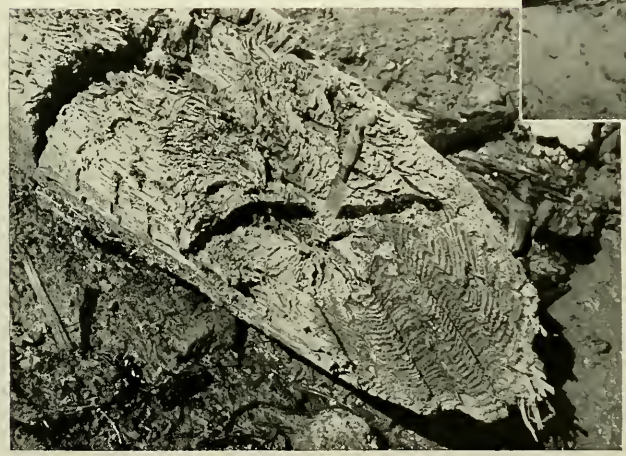
Lombardi photo

(Right) A PREHISTORIC HORN *of the wild ox,* Bos primigenius, *found in peat layers not far from Circe's Mountain.*

Between the last two glacial advances the climate in Italy was probably hot, and hippopotamuses, elephants and rhinoceroses roamed the country. Near the beginning of the last glacial advance, when the Neanderthal man was buried in the cave, the warm pachyderms probably still lingered and were familiar to these people

Blanc photo

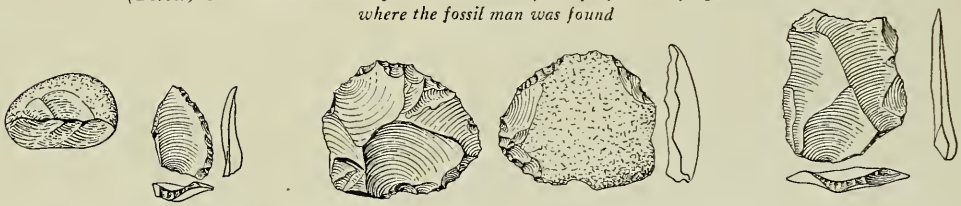
(Opposite page) BONES OF OXEN *and deer lay scattered in several corners of the crypt where the Neanderthal man had been buried at least 70,000 years ago. In the outer chamber, half covered by a small pond, lay remains of an elephant and a hyena*



Blanc photo

(Left) A TREE *which could not grow there now. Additional evidence of the colder climate that prevailed in the Ice Age is given by specimens like this of a cone-bearing tree* (Abies alba), *which today is restricted in Italy's Apennines to elevations of over 2900 feet*

(Below) STONE PIECES *showing the handiwork of the people who frequented the cave where the fossil man was found*



THE WORLD-WIDE HUNT

Lunging giants of the deep challenge the skill of game fisher and anatomist on five successive expeditions from the American Museum of Natural History

THE Age of Chivalry may have passed, but the knights and ladies of the rod and line keep alive its spirit. There are, it is true, no more dragons to be killed, but the royal sport of "drawing out leviathan with a hook" is just as thrilling. No Merlin exists, to lay his enchantments upon the knights, but there are marlins to challenge them in far wanderings over the seven seas. And the Princess, instead of being locked up in a gloomy tower, sails forth under her own pennant to do battle with the lunging giants of the deep.

Fortunately Michael Lerner wanted to capture and recreate some of this glamour and thrill for The American Museum of Natural History. So in every one of his expeditions he took along with him one or more experts in cinematography. And they brought back thousands of feet of film in color and hundreds of photographs, covering the various phases of the field work. He also took with him artists to record the subtle and elusive colors of the great fish, which usually fade out long before the fish reaches the dock, and taxidermists to prepare the skins and make molds of the streamlined bodies. Finally he invited scientists to go with him to measure and observe, and to set up questions which they hoped they might eventually be able to answer. So was developed the plan to extend the quest for swordfish around the world. The accompanying pictures portray some of the activities of the Michael Lerner expeditions for this Museum in 1936, 1937, 1938 and 1939. About the time this article reaches the public, the next chapter will be well under way in the vicinity of Tocopilla, Chile, where, according to schedule, Mr. and Mrs. Lerner will be catching the big fish and Miss Francesca LaMonte, the genial Associate Curator of our Department of Fishes, will be measuring and studying them.

The material results of the Michael Lerner expeditions already include a series of beautiful exhibits in the Museum's Hall of Fishes, together with a great store of records and preserved fishes of various kinds. The more indirect and imponderable results may in the long run be hardly less important. For example the Michael Lerner Australia-New Zealand Expedition of 1939 vitalized the Museum's long planned project for securing adequate natural history exhibits from Australia and New Zealand. Another by-product of the expedition is the establishment of the Internationl Game Fish Association, with headquarters in the Museum, which it is believed will be influential in promoting good sportsmanship and will supply scientists with much needed data as to the geographic distribution of various species of fishes.

The scientific results of these expeditions are being published as they are worked out. Already some 22 articles, in the Museum *Novitates, Bulletin,* and NATURAL HISTORY MAGAZINE have appeared. Analysis of the thousands of measurements already made is yielding clearer definitions of the limits and relationships of the various species and varieties of marlin.

FOR MARLIN

By William K. Gregory
Curator, Department of Fishes and Comparative Anatomy
and G. Miles Conrad
Assistant Curator, Comparative and Human Anatomy
The American Museum of Natural History

(Left) A New Zealand striped marlin, with body tense and tail sculling, leaps from the water in one of a series of "greyhounding" bounds in a supreme effort to shake free of the hook

Photographs by James B. Shackelford and Frank H. Ramsay of the Michael Lerner Expedition and A. N. Brecken, J. F. Louden, and E. V. Simpson

(Right) The marlin is brought to the side of the boat, alive but weary. The boatman in the foreground has a gaff hooked through the back of the fish while the rear man, ever watchful of powerful sweeps of the tail, trusses the fish so that it may be hauled aboard

(Below) Against the colossal backdrop of New Zealand's famed Piercy Rock two of the expedition's boats troll for marlin. On the boat in the foreground can be seen the boom-like outrigger from which the baited hook is trolled

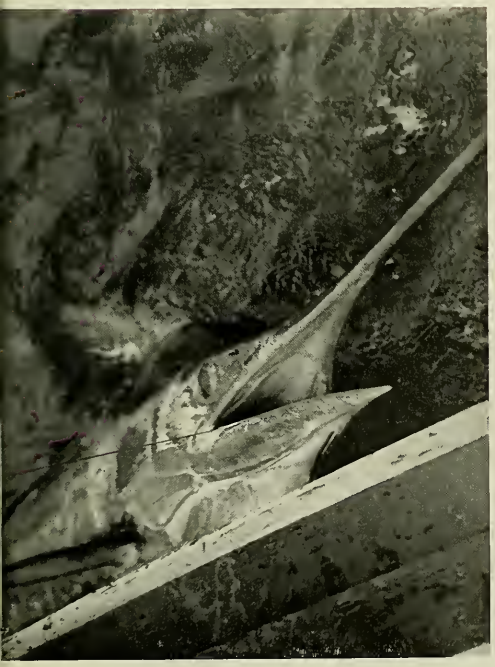
(Above) In this beautiful and well-sheltered haven most of the Bay of Islands' angling fleet lies at anchor. Nestling at the base of grassy, rolling hills stand the cottages of Otehei Bay fishing camp. At the right of the pier on the shore is the expedition's laboratory tent, to which were brought the giant trophies of the sea for preparation and study

Below is the gaping maw of the world's gamiest shark—the mako. Although the mako is apparently confined to New Zealand's waters, its mackerel shark relatives are world-wide. Mako, a Maori word, means shark

The leaping marlin below, completely out of the water, twists violently in an effort to get rid of the hook and line which to it probably seem to be a particularly annoying and persistent parasite

(Above) A DROP into the trough of the sea makes it appear as though James Shackelford and his movie camera were sitting upon the water. Below him in the cockpit of the cruiser are four of his fishing companions

(Above) AS A LAST EFFORT to get rid of the hook, this marlin has "thrown" or everted its stomach. It is only a matter of minutes until the fish will be brought alongside and safely gaffed by the man in the foreground

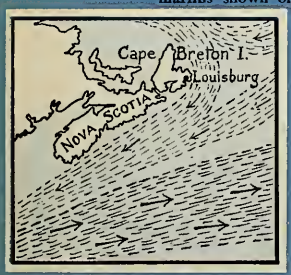


(Left) THE MARLIN has been brought alongside still alive but tractable. The wire leader which has stood the strains of his many leaps stretches taut from the corner of his mouth

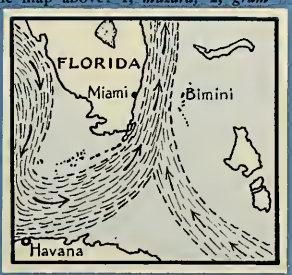
(Right) Now thoroughly trussed with ropes, the marlin is hauled aboard by Mr. Lerner and the crew. Ever-present cameraman Shackelford snaps the event for the expedition records

AMERICAN MUSEUM EXPEDITIONS FOR MARLIN AND BROADBILL

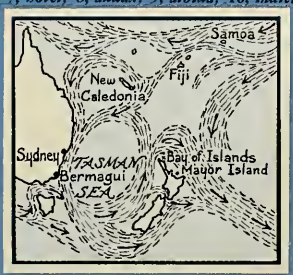
All belonging to the genus *Makaira* are the species of marlins shown on the map above: 1, *mazara;* 2, *grammatica;* 3, *georgii;* 4, *lessonae;* 5, *ensis;* 6, *gracilirostris;* 7, *bolei;* 8, *audax;* 9, *albida;* 10, *indica;* and 11, *herscheli*



At Louisburg in 1936 and 1938 the broadbill swordfish was studied. In summer the broadbills leave the warm Gulf Stream to buck the cold, southbound Labrador Current



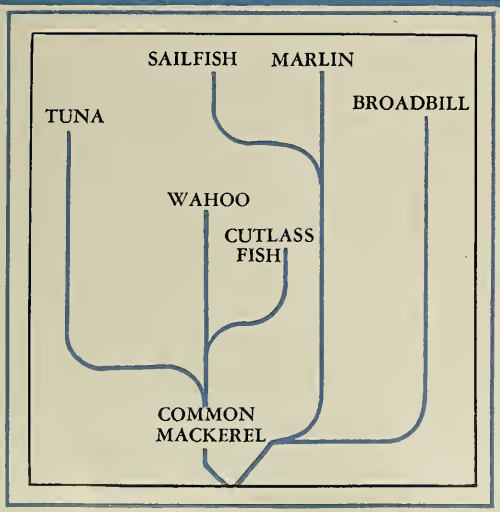
The Gulf Stream speeds northward through the 70-mile channel between Miami and Bimini, sweeping with it the Atlantic blue and the white marlins (1937 Expedition)



Carried southward by the East Australian Current, the striped and the Pacific black marlins pass Bermagui, the Bay of Islands and Mayor Island (1939 Expedition)

In the waters of Peru and Chile a striped and black marlins. Are the really Australian and New Zealan fish following the prevailing cu rents eastward? (1940 Expeditio

Maps compiled by G. Miles Conrad



So similar in anatomy are the cosmopolitan broadbills that zoologists regard them as one species. Not as simple to understand are the marlins for, although world-wide in distribution, they differ in detail. Five expeditions from the American Museum have gathered data on these giant fish. These efforts indicate that the striped marlin *(Makaira mitsukurii)* A of Australasia is the same fish which is found throughout the North Pacific; that the Atlantic blue marlin *(M. nigricans ampla)* B1, Pacific black *(M. n. marlina)* B2, and Atlantic black *(M. n. nigricans)* B3 are all varieties of the same species

The relatives of the marlins and broadbill swordfish are shown in this pedigree of the mackerels. Although tuna, marlins, sailfishes and broadbills have been called "Giants of the Mackerel Tribe" they are hardly first cousins, for their common ancestor must be sought in Cretaceous times, 60 million years and more ago

THE BROADBILL or true swordfish is streamlined in a different way from the marlin. Its fixed and shark-like dorsal fin, although offering extra resistance, is useful in stabilizing the massive head and bill

THE SWORDFISH'S stabilizing and steering fins show up well in rear view

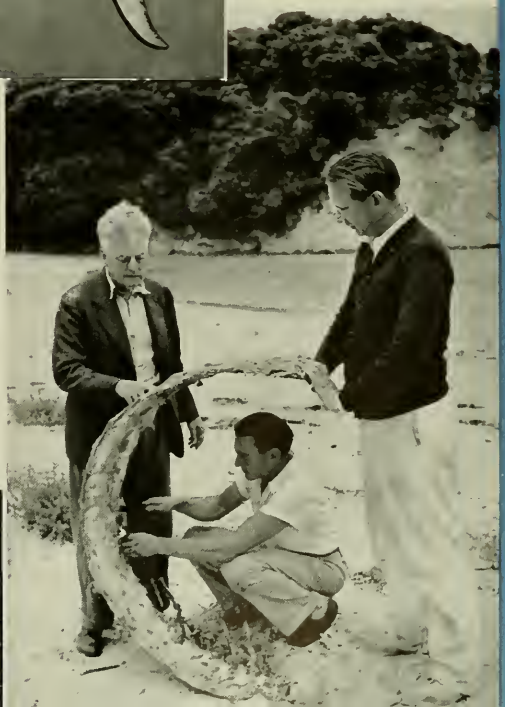
A HEAD-ON VIEW of the swordfish reveals its streamlined oval section

AMNH photos

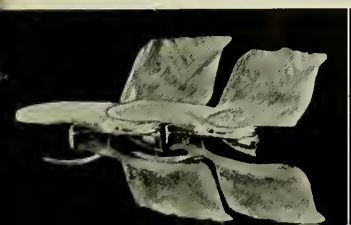
(Right) BIRD'S-EYE VIEW of swordfish. This living torpedo-like projectile may penetrate several inches of wood. A season seldom passes in which a dory is not rammed and pierced

IN THE BROADBILL'S skeleton *(above)* the vertebrae, or units of the backbone, are short and stout, to support the terrific thrusts from the bill and tail. In the marlin, however, the long, slender, overlapping flanges *(compare below)* permit the backbone to bend and rebound like a steel table knife

(Right) MEMBERS OF THE EXPEDITION demonstrate the spring-like quality of the marlin backbone. The very rigidity which aids the "greyhounding" leap makes a powerful spring of the backbone. When released this vertebral column flew several feet in the air. Coupled with muscle power, this spring drives the marlin through the water at high speeds



MARLIN VERTEBRAE



BROADBILL VERTEBRAE

(Left) Mr. and Mrs. Lerner pose with a remarkable catch—two striped marlin flanked on the left by a mako shark and on the right by a thresher shark. The great, long tail of the thresher shark gives him powerful leverage for swimming, and while he is not considered a "gamy" fish, a long, back-breaking pull is required to boat him

(Circle, below) Keith Gifford, secretary of the Mayor Island Fishing Club, attaches a message to the leg of a carrier pigeon which will carry news of the catch and orders for supplies to the mainland

(Below) Ferraglio, Conrad and Hatch look on while the carpenter measures the height of a plaster mold of a marlin for the crate he is building

(Bottom) Back from a day's fishing, Mr. Lerner *(right)* and Captain "Bill" Hatch *(left)* stride up the beach carrying their heavy deep-sea rods and reels. Mrs. Lerner waits for an ebbing wave before leaping ashore from her dinghy. At anchor ride two of the expedition's cruisers

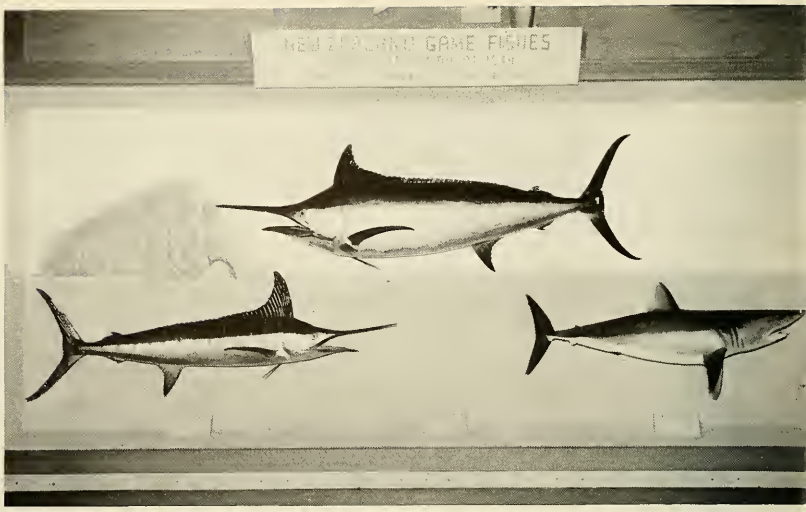
(Above) All hands pitch in to help remove a mold from a choice black marlin caught at Bermagui, New South Wales. The central figure is Clive Firth, president of the well-known Bermagui fishing club

(Right) At Mayor Island the expedition had to construct a ship-to-shore ramp up which the heavy crates with their fragile molds might be carried. From Mayor Island these molds were shipped via Auckland directly to the American Museum

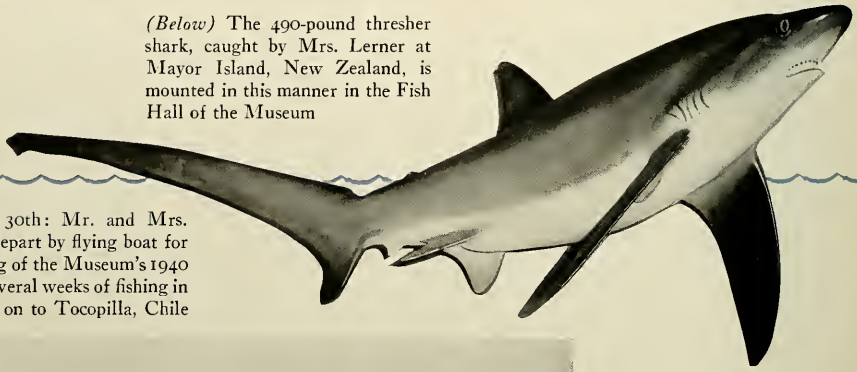
In 1936 and 1938 Michael Lerner led Museum expeditions to Nova Scotia. The view below shows a part of the swordfishing fleet as seen from the expedition's laboratory at Louisburg, Cape Breton Island. Two swordfish *(Xiphias gladius)* hang at the end of the pier

(Below) Miss LaMonte and the Messrs. Conrad and Lerner pose with an Atlantic blue marlin caught by the latter on the Museum's expedition to Bimini, Bahama Islands in 1937. The Gulf Stream at Bimini abounds in game fish, notably the blue marlin

(Right) Displayed to public view for the first time at a joint meeting of the Museum and the Australian and New Zealand Societies on April 4th was this exhibit of New Zealand game fishes. Left, a Pacific striped marlin; right, a mako shark; and above, a black marlin weighing 708 pounds



(Below) The 490-pound thresher shark, caught by Mrs. Lerner at Mayor Island, New Zealand, is mounted in this manner in the Fish Hall of the Museum



(Below) Miami, March 30th: Mr. and Mrs. Michael Lerner about to depart by flying boat for Talara, Peru, on the first leg of the Museum's 1940 marlin expedition. After several weeks of fishing in Peru, the party will move on to Tocopilla, Chile

AN INSECT JEKYLL AND HYDE

A Story in Candid Snapshots

By George Elwood Jenks

The hunting wasp whose remarkable life is shown here, like the well-known dual personality of fiction, plays two separate roles, that of a sort of "lotus eater" and that of a fierce huntress. A strict vegetarian, she flits through the California sunshine, sipping nectar from flowers. Then, for the sake of her children-to-be, she becomes the assailant of the trap-door spider, to whose hidden nests an unerring instinct seems to lead her.

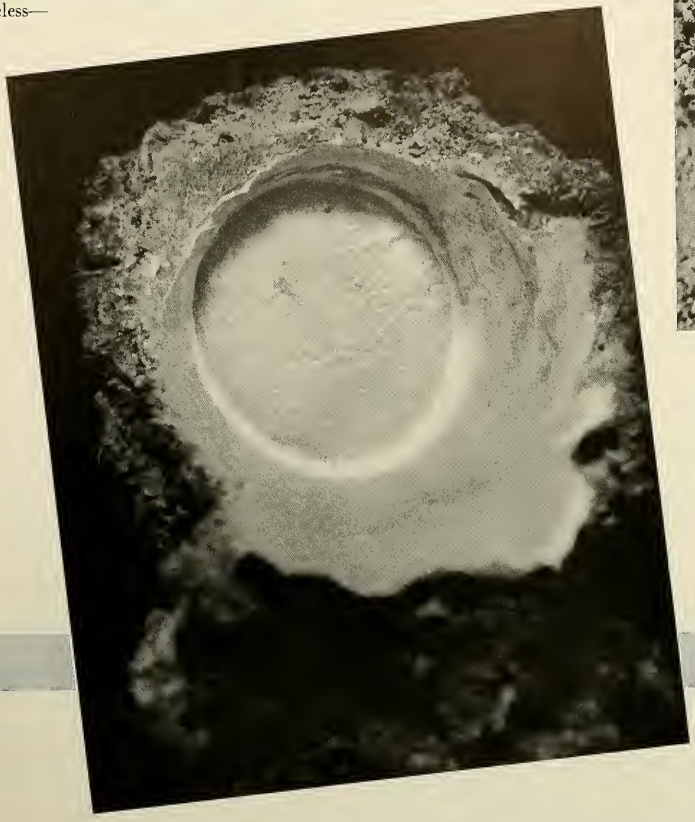
In an official census she would be classified as *Pedinaspis planatus* Fox, of the family Psammocharidae; but since we propose to delve into her private life and know her intimately, we will waive formality and call her "Psammy"

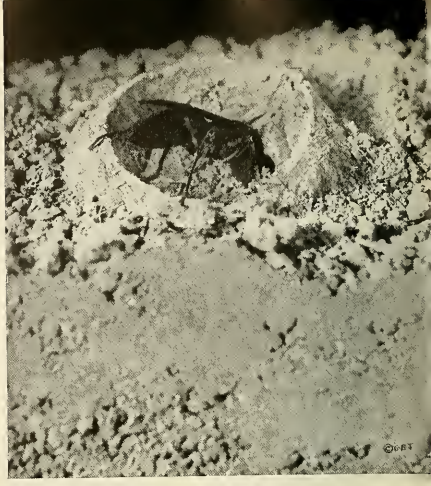
[The underground insect drama that is portrayed pictorially on these pages is a result of three solid years of investigation by George Elwood Jenks into the actions and habits of the trap-door spider and its parasitic enemies. Inquiry at the outset revealed that very little was known of the life history of this hunting wasp, and that less than half a dozen of its cocoons had apparently ever been found. During the years that followed, the author found and dug up more than 3000 trap-door spider nests, from which he secured over 100 empty wasp cocoons and 100 "live" ones. From these he reared the adults in his homemade laboratory, propagated others, and subsequently witnessed the growth of 150 individuals from egg to adulthood. His intensive studies give us this glimpse of a fascinating link in the chain of insect life, which for how long one can scarcely say has been revolving in the cycle of birth, struggle, and death beneath the surface of the earth.

Readers aware of the difficulties of photographing active insects may be interested to know that in recording over 2000 scenes during six years of camera work with insects Mr. Jenks has used posed insects (dead or anesthetized) less than a dozen times, of which No. 5 in this series happens to be an instance.—Ed.]

1 In search of a trap-door spider whom she can paralyze and use as food for her as yet unborn offspring, Psammy lifts the lid and slips down into the spider's underworld. If the door is "unlocked," she can lift it easily with her claws, but—

2 —this spider usually seals its door from below with strong silk in summertime, which is "siesta time." Nevertheless—





3 —Psammy seems to know that the fat spider is lurking below and proceeds to rip a hole through the trap door with her powerful jaws, or mandibles

7 Psammy's poison sting strikes home, and the spider which is to nurture Psammy's larva wilts in a helpless paralysis

8 After satisfying herself that the spider is in just the right state of coma, Psammy lays her egg on the fat abdomen, and departs to raid another underground home

9 The egg hatches in a few days, and the tiny larva finds itself lying upon a huge store of food, which is fresh and sanitary because it is still alive, though probably insensible to pain

4 Down below, the spider—as helplessly cornered as one of the Forty Thieves in the Ali Baba story—looks up to see—

5 —the blue-black invader forcing her way through the shattered doorway. Down the tube the marauder flashes in a twinkling

6 A rough and tumble fight ensues, which is almost too fast for the eye to follow or for the camera to catch. Then—

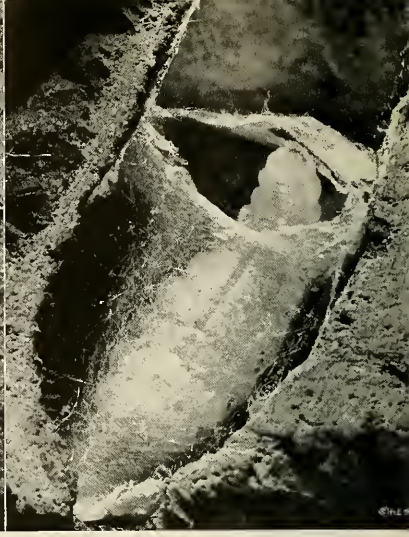
10 The little maggot has nothing to do but eat, and so it grows rapidly

11 Having neither fingers nor forks, the full-grown larva places a spider "drumstick" on its "chest" and manages quite well, thank you. Apparently this larva, as well as the larva of *Ocnaea smithi* Cole,* possesses some sort of suction disc, for both make their way up and down the vertical walls of the spider's tunnel as easily and securely as a snail might

*See "The Spider's Uninvited Fly" by George Elwood Jenks, Natural History Magazine, March, 1940.

12 Now the guzzling mouth becomes an efficient "spinneret," as the little creature starts to spin the guy wires for its cocoon

13 Here we see it spinning the framework of what is to be a marvelous two-story cocoon. The "cap" at the top is a temporary scaffolding which will support the "roof"



14 With another kind of liquid silk the maggot "licks in" the "roof." This is a circular diaphragm of waterproof "Cellophane," which completely seals the spider's tube. When the walls of the attic room are also plastered, the larva settles down and—

18 —the larval skin sloughs off, and the first ghostly pupal form is revealed, watery and transparent in appearance. Then, like a picture slowly coming into focus—

19 —the form grows more compact, the eyes darken, and it takes the clear-cut shape of the wasp-to-be. For several days it remains opalescent white, and then—

15 —seals itself within the inner cocoon, the head of which is snug and dry within the attic room. One asks how this ugly creature—seemingly only a bag of digested spider meat—can have the "intelligence" to construct this perfect and intricate cocoon

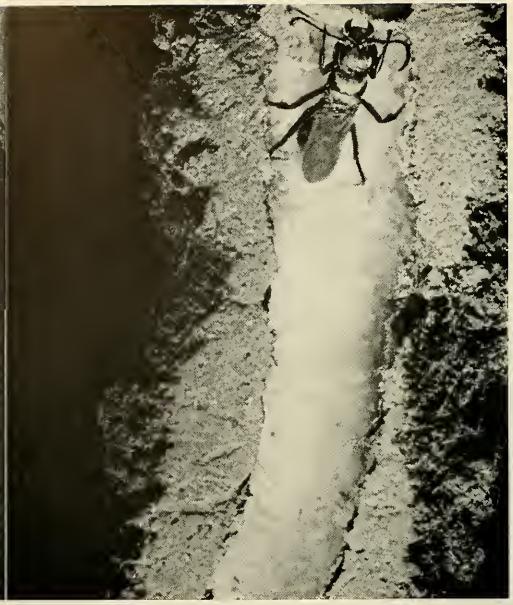
16 But we won't let the creature hide out on us. We will just put an observation window in the wall of the cocoon and spy upon her during the long winter. For months no outward change is visible, but—

17 —with the warmth of spring, radical changes begin to take place. It appears that the pupa (the form which proceeds the emergence of the perfect insect) is developing within the larval skin. (Technically, this is known as the prepupal larval stage.) And then, one day—

20 —as if a sac of black ink has been released, the color spreads slowly throughout the body. The overlapping armor plates form and harden

21 Full-fledged, she cuts a circular trap door in the top of the cocoon. The vertical cut was made to show its marvelous structure. But where has Psammy gone?

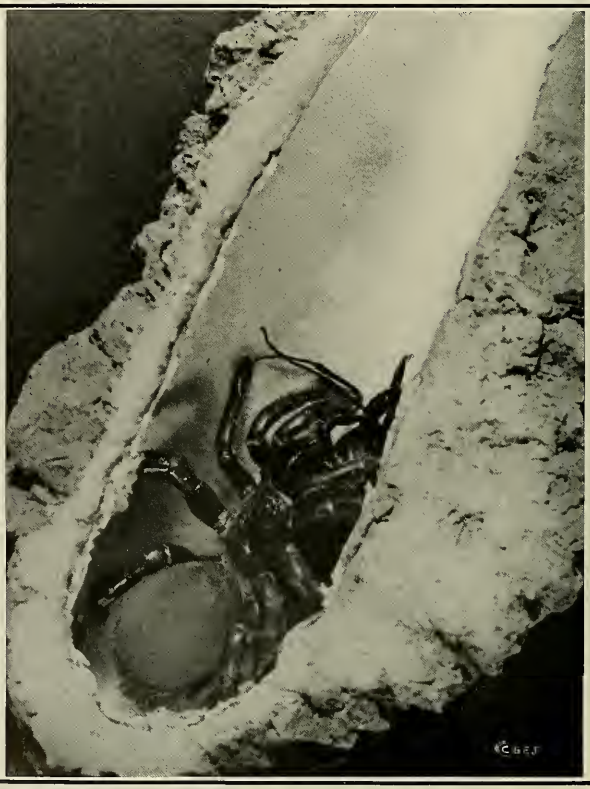
22 Here she is—primping, of course. Then up the tube she goes, eager to make her debut in the upper world of sunshine and flowers



23 Up goes the trap door; or she may have to rip a hole through if it is stuck. Psammy emerges to a "lotus eater's" life as did her mother before her

BUT

Like her mother, sooner or later the other personality will dominate her, and she will become a tireless huntress among the silk-lined caverns of the trap-door spider underworld



24 But retribution usually overtakes her. Though Psammy is a clever and fearless fighter, the spider whom she victimizes is often far heavier and stronger. And sooner or later the huntress will probably make a fatal slip, to die "with her boots on," in the clutch of an intended victim

—Continued from page 270

one. True, the bird probably attacks schools of close-swimming fry, but certainly it cannot scoop in a half dozen or more in one thrust. Possibly the answer lies in the fact that the roof of a puffin's mouth has numerous hard ridges between which the fish may be wedged as they are taken. Be that as it may, the fish-catching technique of the puffin is a remarkable energy-conserver. One trip to the sea is good for several fish!

After nearly two weeks of observations in Puffin-Town I obtained in my own mind a fairly coherent though sketchy picture of the individual and group behavior of its fascinating residents. My picture I consider a normal one, for I was careful to see that natural conditions prevailed, that I did not linger too long in view of the colony, that I did not disturb the birds too greatly by examining too many nests at one time.

I am guilty, however, of having created one unnatural condition, but not until I had carefully watched the colony over a period of days. I had good reason for making this experiment, for I wished to settle in my own mind the question: is a puffin as inquisitive as it looks?

I brought to Puffin-Town a mirror, propped it upright on a favorite common, with the glass facing my blind. I then hid in the blind and awaited results.

Slowly the colony settled down, and several puffins gathered on the particular common with the mirror. For a short period the mirror remained unnoticed until one puffin casually alighted directly in front of it. Finding another puffin that mocked its every movement, the new arrival stared at it coldly. Tiring of this attitude, the bird approached the mirror until it met its image beak to beak. The bird then attempted a tug of war with its imaginary opponent and tipped over the mirror.

I disturbed the colony by leaving the blind and replacing the mirror. Again I returned to the blind and again the colony settled down. This time a puffin accidentally pattered past the front of the mirror and caught sight of its image as it went by. Seemingly bewildered at seeing this bird ever so briefly, it turned quickly about, went back to the mirror and stood in front of it a few seconds. More curious than fooled, it moved up to the mirror and pecked at the gilt frame, then stretched its neck sidewise and peered around in back. Soon it walked away in the direction it was going in the first place.

A little later another puffin stepped up to the front of the mirror and started bill-clicking with its image. This performance attracted a second puffin which ambled up to the mirror and at once indulged in bill-clicking with its own image. Confusion immedately resulted. Each puffin found three other puffins with which to click bills. Excitedly they clicked bills, first among themselves, then with their images, then with the images and themselves. I have no idea how long this performance would have continued. Unfortunately it became too animated and the mirror, pushed vigorously from its position, fell and was broken into many pieces.

When I left Puffin-Town late in July, I hoped Puffin-Town would not have seven years of bad luck.

Time has entirely disproved the mirror-breaking superstition in so far as Puffin-Town is concerned. I revisited the community in 1937 and found the population to have increased by one hundred pairs and to be occupying crevices on the western and southern shores. I am informed by reliable sources that the number is still increasing.

Fortunately Puffin-Town of Machias Seal Island is blessed with good though unofficial protection. It so happens that the Canadian Government operates a lighthouse in the center of the island. The keepers find in these peculiar birds a perpetual source of company and amusement, and guard them zealously. Human visitors to Puffin-Town they always welcome, but not wild predators nor malicious domestic animals. The puffins of Puffin-Town, by their own human appeal, have earned protection during their hazardous months ashore.

PIGEON #183/14 A.F.

By SYDNEY MOORHOUSE

During the defence of Verdun in 1916 pigeons proved their worth and no less than 5000 birds were pressed into service by the French. Each message was sent in duplicate so that if one bird was unfortunate enough to be hit by enemy action, the vital words could still be carried through by its mate.

It was during that historic action that pigeon 183/14 A. F. performed a feat that won him an everlasting place in the annals of the Great War. The pigeon was the last one remaining with Major Raynal, defender of Fort Vaux. As all the other birds had long since been released with messages, it fell to him to carry the most important communication of all.

"We still hold out," wrote Major Raynal, "but are undergoing a dangerous gas and smoke attack. It is urgent to relieve us. This is my last pigeon."

Through an atmosphere thick with the yellow and green of poison gas, an atmosphere through which no airplane could penetrate, and with shells continually bursting around, the bird made his way to clearer air and then sped for headquarters. Within an hour relief was on its way, and only just in time. Verdun was saved!

It has since been said that the defence of Verdun saved the war. If this is so, then pigeon 183/14 A. F. was one of the heroes of the war. And, appropriately enough at Verdun itself is a plaque commemorating this epic flight.

THE VANISHING AFRICAN

How the modern detribalized native reacts to the clothes and customs of a machine age

By D. R. Barton

IF we pin a Rip Van Winkle ending on the oft-told tale of Stanley in Africa, many romantic notions of that picturesque country will undergo rather extensive revision. For considerable water has cascaded down Victoria Falls since Stanley "rescued" Livingston; and the murk of a once dark continent has grown increasingly dilute.

Seventy years ago, Henry M. Stanley left Bombay and after nearly three months of spectacular hardships reached Livingston's outpost on Lake Tanganyika. Today, Mr. Spencer Tracy, in or out of character, could cover the same ground in three effortless days without so much as spotting his linen suit. But it wouldn't make a very exciting movie.

Though we may regret this magical acceleration of African transportation as a blight to romance, it should not preclude all possibility of adventure. One may still expect the unexpected even in modern Africa. And this holds particularly true for a resurrected Stanley.

If he hopes to renew acquaintance with any of the barbaric tribal headdresses so familiar in slave-raiding days, the search will take him well into the interior. And even if he does manage to ambush a chieftain still partial to the old ceremonial costumes, he may see little of interest unless the visiting party is sufficiently affluent to warrant the declaration of a feast day.

But surprise attacks await the returning Stanley in the urban areas! As he enters town, a striking example of the new, detribalized native saunters down the street. The oncomer's pith helmet sets off an ancient woman's bathing suit, complete with braided sailor collar. On his legs, winding khaki leggings are covered with leather puttees. But he wears no shoes whatever.

Before Stanley has quite recovered his composure he bumps into another native. This one is wearing an old style loin cloth, *but* though it is high noon, he has topped it with a splendid tuxedo dinner jacket. Stanley seeks a shady spot to escape a little of the equatorial heat and is immediately flabbergasted at the sight of the perspiring village carpenter working away in a full length, regulation army overcoat, which he disdains to remove or even unbutton.

Photo by John Park

The local commissioner reports that such apparitions are not uncommon. The worst case in his official experience was the village loafer, an aging male negro, who dazzled the populace with a cheap lace chemise tucked inside a pair of tight-fitting duck trousers. The latter were rolled up to expose pea-green silk

A gigantic Dinka *(above right)* in his natural "at ease" stance. These Dinkas are among the few tribes relatively unaffected by civilization. For contrast, note man pulling the mule *(right)* whose garb scarcely distinguishes him from a Kentucky stable boy. A chief (seated) is "teaching" his mule to pull the cart by the example of his slaves

socks supported by hand-embroidered garters. For shoes he wore carpet slippers, and from his belt, like a grotesquely stiff tail, dangled a sky-blue parasol.

Why they do it

The mystery of the African's use and misuse of European clothing is by no means inscrutable. Far from being merely a barbaric love of the garish, the motive is usually a child-like effort to understand the significance of the white man's garb.

In some of the cases cited above, sex dress distinctions were disregarded, and separately presentable but collectively incompatible garments appeared as ensembles. Naturally, this produced a motley effect which to us seems ridiculous. But it must be remembered that native tastes had already been corrupted by the early traders, who were prone to stimulate a fashion contradictory to both white and black standards if it enabled them to unload overstocked or obsolete goods.

Among the fads introduced by traders was the love of cheap hardware. Before wireless telegraphy became practical, the British had a hard time trying to establish a communications system by stringing telegraph wires across the wilderness. Unless they were nailed very high on the pole, herds of giraffes had an irritating knack of running into the wires at top speed with surprisingly destructive effect. And no matter how high the poles were made, there was no stopping the natives who shinnied up and cut down the wire to make ornaments. Any white man fool enough to leave a lot of pliant, shiny wire around on poles deserved to lose it.

This avidity had previously been instilled by traders of another day who found copper wire a handy and inexpensive currency. The natives at that time had no use for European money, but some, being primitive iron-smelters, had learned from centuries of tribal experience how to fashion metal ornaments by dint of hard labor. Here was something bright and new in a very convenient form that could be twisted quickly and shaped into all the old ornaments and many new ones. Thus the more accessible the European metal goods became, the more the native lost his indigenous metal craft. All over Africa, the primitive forges began to go out.

This illustrates one of the main aspects of the manifold war of cultures. On all fronts, the mighty European civilization triumphed, undermining the old tribal methods, together with the aboriginal social organization. Today, the African has become a ceaselessly exploited customer of giant corporations in England and America rather than a satisfied practitioner of his individual handicrafts. And he is daily striving to further emulate the Master Race without yet having discovered quite how to do it.

Indeed, the native's* ideas of the proper uses of white man's paraphernalia sometimes develop strange ramifications. Boots are among his most highly prized possessions, and not long ago he used to carry them whenever he was traveling any distance. Why wear them out? Feet are for walking, shoes for show.

One man acquired a pair of huge French army boots. Later, someone passing his hut noticed that a wooden floor was being built about three feet above the still perfectly serviceable, clay floor. Since this superstructure made things rather cramped, it was difficult to understand his motive. Finally he admitted that he had installed the plank flooring simply to stomp on with his new boots. Because of the drum-like cavern beneath the boards, he could raise a terrific racket, and, grinning, he proudly announced that *his* floor sounded even louder than the white man's.

Imagine the incisive impression made on a simple bush negro by his first visit to the headquarters of the local constabulary. Here dwell the big men of the Master Race—and what a fine noise their boots make as they stride around the floor! How important it sounds! How official! Is it then so surprising that he sets out to acquire a pair of thick-soled boots and a plank floor to thump on? Our children respond in much the same way when they put on heavy riding boots and other hard-soled adult footwear.

Not many years back, our high school boys used to race their cars in second gear, rejoicing in the illusion of dare-devil speed produced by the roaring motor. So it is really quite understandable that when a native first gets hold of a motor car he is apt never to run it in high gear, because second or low get so much closer to the fundamental auditory appeal.

Once in a while, the chief of an interior village scrapes together sufficient money to buy an exceedingly ramshackle auto. After filling the tank with gasoline at the local station, he departs for his native kraal, where he goes roaring around the navigable terrain to the astonished delight of his people

* Since this discussion is designed for general readers, and since essentially identical forces are at work nearly everywhere, no attempt has been made to designate the tribal and colonial divisions into which Africans are divided.

A. M. N. H. photo by Herbert Lang

Gaudily uniformed native policemen *(above)* and airplanes are beginning to replace animals in many native carvings

A. M. N. H. photo by Herbert Lang

—until the gas runs out. As the engine emits its final cough, the chief simply steps out, leaving the jalopy wherever it happened to stop. But each fine day thereafter he climbs back into the inert vehicle to hold palavers with the notables of his village, sunning himself the while in the driver's seat. In rare cases, the car may remain standing there as a sort of monument, until it disintegrates. But usually a chief will send for more gasoline and rapidly learn enough about his latest symbol of rank to make regular trips to the filling station for general servicing.

Some years ago, a certain chief saw that white men were doing a good deal of traveling over the rougher parts of the country in horse-drawn carts. Accordingly, he bought a mule, which happened never to have been wagon-broken. The chief was quite disappointed when the animal began to kick and buck between the shafts. After some thought, he decided to teach the mule by example. He ordered his pupil to be dragged along at the rear of the cart, from which vantage point, it could get an idea of what it was supposed to do. Meanwhile, several slaves, acting as demonstrators, hauled the cart around the village at a great clip —an actual, and really not illogical instance of "putting the cart before the horse."

The arts

African folk-tales usually deal with animals and are generally windy, formless, and bristling with loose ends. To the white listener they seem to be "getting nowhere." Under European influences, however, these characteristics are rapidly disappearing and we see the beginnings of foreign plot structure. Spurious versions of European fairy tales have been improvised, appealing to the pygmy's dreams and aspirations. The following retains some of the fanciful figures in fairy stories but modifies them in conformity with native experience and a dim infiltration of not too recent European history.

The tale itself concerns our hero Zumbo (sometimes the speaker will substitute his own name), an African boy who is an excellent cook, mechanic, and cobbler. He hears that the Kaiser's daughter has been stolen by the King of Italy. The Kaiser promises 500 head of cattle and the Princess' hand in marriage to the man who will rescue her, so Zumbo starts out for Italy in his motorized dugout canoe. Landing in Italy, he finds work as a cobbler and repairs the Princess' shoes. She is so pleased with the results that she asks to meet him, and Zumbo whispers that he has come all the way to rescue her. Using her influence with the King, the Princess gets Zumbo a job in the palace kitchen, where the head cook is always drunk on palm wine. One day, while the cook is sleeping off a drinking bout, the King orders a great banquet. Zumbo "cook very fine chop," and when the King descends into the kitchen to praise the cook, he finds that Zumbo prepared the meal all by himself. Thereafter Zumbo ranks high in the King's favor. But while the latter is off on a hunting trip, Zumbo steals the Princess and sets out for Germany in his little motor boat. The Princess gives Zumbo her ring as a token of affection. But at this point they are waylaid by a German warship, whose captain smashes up Zumbo's boat and steams off determined to marry the Princess and claim the reward for himself. But Zumbo is so clever a mechanic that he completely repairs the engine out of an old gasoline tin and sets off in pursuit. Arriving in the midst of the wedding ceremony, Zumbo produces the Princess' ring to show that he is the original rescuer and her true-beloved. Whereupon the benevolent old Kaiser, oblivious to racial distinctions, hands over the Princess and most important of all, 500 head of cattle.

We have all seen natives pictured with ornaments of ivory and other indigenous materials thrust into gaping holes in the lips and ear lobes. But few of us are aware of the remarkable variation in the fashion that has come about in recent years. No longer do many of the women in these regions place hand-wrought ivory disks in their lips. Instead they use watch crystals which are easily come by at the village store. Or if the prevailing mode is to pierce the lip vertically with an ivory skewer, this is replaced by a splinter of beer-bottle glass that can be rubbed to smoothness on a stone during a chat with a neighbor. Some white man tossed the bottle away. There it was, convenient, easy, ready at hand. No one had to go out and kill an elephant for ivory. No one had to sever the tusks. Or split them up. Or concentrate long hours on working the hard white material into the desired shape. Here is a remarkable substance—*free*. So the African takes it up. Bottle glass or watch crystals in the lips, and most prevalent of all, circular English cigarette tins in the ear lobes. Some feel that this last is merely the pocketless native's way of carrying his cigarettes. But more likely the African, here as elsewhere, is simply following the line of least resistance.

The white man finishes his 50 cigarettes and chucks the tin into the refuse. The native comes along, picks it up, finds it round, smooth, *convenient,* and finally adapts it to an age-old custom which probably long antedates the use of tobacco by Europeans. Assuredly, this *is* a "modern convenience."

But, inseparable from all the conveniences which, deliberately or by accident, we have bestowed on the African are the besetting sins of Western culture. While it lasted, the tribe generally made a pretty good framework

THE TALL TRUTH

ANCHORITE OF THE ROCK

In the early part of the Christian era, a great hermit movement developed. Men sought to save themselves from the evils of the world by retreat into the desert, shutting themselves off from human contact. Others had themselves walled up in cells, depending on others to keep them supplied with the bare necessities of life. But few men can endure complete isolation. One of the severest punishments is to condemn a man to solitary confinement, and one of the mental abnormalities is a horror of being shut up.

There is a mollusk that knows nothing of claustrophobia, or fear of confinement. Along rocky shores small holes may be seen near low tide mark, penetrating into the solid rock. Inside, in a smooth chamber, lives a rock-boring clam (*Pholas*). The chamber is much larger than the opening, and the rock-borer cannot come out, nor can it live outside of its cell. When it was no larger than a grass seed, the clam gave up its free life to dig into the rock. As it grew up, the chamber was enlarged, bit by bit. It may reach the size of a large potato.

As the tide rises over the cell, the rock-borer extends its double siphon to the opening, which has been enlarged proportionately with the growth of the siphons. One tube of the siphon draws in sea water by the beating of millions of hairlike cilia. The water passes out of the other tube, after making a circuit of the clam, carrying oxygen to the gills and minute plants and animals to the mouth of the clam.

The isolation of these animals is usually complete, although many may be in a single rock, but it does not interfere with the propagation of the species. The outgoing currents of water at the proper season carry myriads of minute germ cells, eggs or sperm. These unite in the sea; and, after a brief free time, some of the young find suitable rocks to bore into, and life goes on.

JOHN E. HILL.

The fish with the pantry in its tail

THE SOUTH AMERICAN LUNGFISH *(Lepidosiren paradoxa)* is a strange, eel-like creature which lives in the muddy swamps of Paraguay.

In the rainy season, when there are several feet of water covering the swamps, the lungfish swims about devouring

huge quantities of snails and algae. This food the foresighted Lepidosiren stores up in the form of rich, yellow fat in its tail.

As the swamps dry up, the lungfish burrows into the mud, eventually tunneling out a deep retreat plugged with a mud cork. Here the Lepidosiren stays during the entire dry sea-

son, living on the food it has stored up in the pantry in its tail.

In the declining years of many a man's life, too, comes a long, lean, dry season, when his earnings become smaller or stop altogether.

But, if he has been wise, he can then live peacefully and well on the "fat" stored up in a life insurance policy; for

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PATON RANCH, Shell, Wyoming

DO NOT MISS

Readers of NATURAL HISTORY may look forward to a rare treat in the next issue of the Magazine in the form of a pictorial journey to the celebrated Central American ruins of **CHICHEN ITZA:** a superb series of photographs by Laura Gilpin, enlivened by running comment by the archaeological authority George Vaillant.

No jungle beast has ever approached the feat of **JUMBO,** the gigantic African elephant who captured the love and admiration of two continents. Leonard J. Bolger's heart-warming recollection of the adventures of Barnum's memorable "star-attraction" will give the engaging story behind an unusual museum exhibit.

In **THE CREATION OF AN ISLAND,** William K. Gregory and G. Miles Conrad will integrate the scientific approach of geology and biology to form a fascinating history of New Zealand from the time it first emerged from the sea to the present. Actually a trio of islands, this country is a naturalist's wonderland, perhaps occupied by a more puzzling variety of life than any other region of comparable size.

The next issue of NATURAL HISTORY will also present an illustrated symposium on **AMERICA'S RAREST TREES,** a triple-starred feature of fundamental educational value.

Alexander M. Phillips' remarkable illustrated story, "Spirit of the Beach," in the June issue of NATURAL HISTORY will reveal the strange habits of the elusive **GHOST CRAB,** the only large crustacean of the North Atlantic to live a good part of his life on land.

Another attraction in the June NATURAL HISTORY will be two pages of exceptional photographs in full color.

for the African to live in. True, the infant death rate was high, but fewer, far fewer, children were raised to unhappiness and frustration in a world that says one thing and does another. Tribal organization was an experiment in living that showed marked success in its time and place. And today it is being destroyed in no small part by a cunningly contrived piece of metal work so easy for the white man to duplicate that he simply throws it away when he has finished eating or smoking or drinking its contents.

Any tin can is welcome, but the greatest all-purpose material is the discarded gasoline can. If the bottom of a dugout canoe needs mending, a gasoline tin is quickly bent into shape and nailed over the leak. If a man wishes to go on a long journey through dry country, he seldom bothers to get himself a gourd, but simply fills a discarded gasoline tin from the spring and starts on his way. If he wants a drum, he does not trouble to make one in the beautiful design bequeathed by his ancestors, but simply upturns a tin and pounds on it. His complete dependence on this curious article is clearly illustrated by the pygmy story of Zumbo who repaired the motorboat engine, using one of these tins to make over all the parts.

Together with the wooden packing crate, this cast-off receptacle is rapidly destroying native architecture. Where formerly huts were thatched with plant materials of the vicinity, they now present a glittering surface of tin cans, hammered out flat as shingles. And when the rains come, an eye-sore village of rusty roofs blights the landscape. These roofs are supported by square-built shanties walled with flimsy pine boards removed from crates. Such are the dwellings that white culture has provided to replace the symmetrical native huts. And, ironically, they are startlingly like the abodes of America's unemployed during the 1931-32 era—the "Hoovervilles" of bitter memory.

One locality reports that a metal roof is every native's ambition. This covering bakes to griddle-heat in the sun, leaving the interior exceedingly hot at night. Yet the natives have so forgotten their tribal resourcefulness that they never seem to think of adding a simple, ceiling insultation of canes. Since they admit the discomfort, their desire for metal roofing can only be attributed to a fast changing set of values.

In the tribal days, the individual was subservient to the group, which usually practiced a primitive communism. According to custom a man proudly displayed his wealth by giving it away! But now all that is finished. Free to demonstrate his superiority in a competitive, individualistic white man's culture, the native is developing a corresponding means of expression. The metal roof is one of them. It is not a tribal fashion in which the community takes part, but a sort of caste emblem to be strived for—a tangible symbol of economic advancement. Today the African is "keeping up with the Joneses." The moment he can afford it, he buys a small "suburban" plot, roofs his house with tin, and hires a couple of servants.

Movies

Although he shows a peculiar readiness to fall in with the white man's way of life, the native is not always as wonder-struck by our inventions as the more self-satisfied would like to see him. In his eye, the airplane has become quite as common as the cigarette tin, and each seems almost equally inexplicable. Frequently the result is an attitude of indifference. This point is illuminated by an experience of Dr. James P. Chapin* of the American Museum's Bird Department. When Doctor Chapin was in the far interior of the Congo in 1913, a white man visited the post bringing a small Pathé movie projector. Since this gentleman was the first exhibitor ever to demonstrate in the region, something in the nature of a riot was expected when all the natives were invited to see the show. His most sensational film was *The Judgment of Solomon,* a biblical period piece portraying Old Testament characters in Old Testament costumes. One messenger boy was so overwhelmed by the spectacle that he rushed to the next post predicting the arrival of a man "who has God with him in an iron box."

On the other hand, most natives, while they thoroughly enjoyed the performance, did not seem particularly impressed by the invention that made it possible. Asked what they thought of it, they merely shrugged and said, *"Mayeli ya muzungu"* ("That is the cleverness of the white man").

In this instance the native did not

* For nearly all the observed incidents and much of the theory reported in this article, I am in debt also to Henry C. Raven, James L. Clark, Gardell D. Christensen, Robert W. Kane, and T. Donald Carter of the scientific and art staffs of the American Museum of Natural History.

even try to understand. But usually he likes to guess. Puzzled by Museum expeditions, the porters in one of Doctor Chapin's camps whispered that America had no birds and that *Bwana* Chapin had been commissioned to bring some back to America. And the *Bwana's* sketches of foliage for background material in habitat groups were explained as designs for cotton prints like those on sale in the local store.

Because of the preponderantly commercial character of the white conquest of Africa, natives often have the idea that Museum expeditions are out to make a tremendous amount of money from their collections. One guide became convinced that his expedition was after shoe leather. Because of the anxiety of the leaders to secure okapi, he was sure that okapi shoes would fetch an enormous price in America.

Most amusing, though touched with irony, was the reaction of natives when members of the Preparation Department recently set about collecting native grasses for African habitat groups. The rumor spread (shades of the dust bowl!) that there was no longer any grass left in America to feed the cattle and that the expedition had been dispatched to collect food for our discontented cows.

Another expedition gained an unusual insight into the degeneracy of native art by conducting a competition among the camp boys to see who was best at decorating gourds. When all the contributions were in, it was found that the boys from the bush carved pictures of antelopes and snakes and other traditional animistic designs, whereas the more "sophisticated" town boys decorated the exterior surface with an up-to-date motif of automobiles, airplanes and impressively uniformed native policemen.

In Abyssinia a Museum party visited a section famous for its beautiful, brilliantly dyed native baskets. In reply to admiring comments, one of the chiefs said, "Yes, they are selling very nicely; but the cost of importing Diamond dyes from America is hitting us rather hard."

The native mind

We must not be drawn into the facile supposition that the native's essentially childlike approach betrays a low grade mentality. There seems to be no scientific evidence to warrant such a conclusion. In one school district, the average intelligence of a first literate generation of blacks measured 85% of the average for white children reared in educated English families with several generations of scholastic training behind them. Furthermore, the white man is learning to rely on the African's ability in various pursuits where his aptitude seems definitely superior. One of the most interesting examples comes from medical centers deep in the interior where the black boys serve as laboratory technicians. Doctors quickly discovered that some natives had extraordinary patience and liked nothing better than making blood counts. Pressed on to more complicated microscopic work, such as tracing down signs of malaria and testing for the presence of numerous bacteria, natives mastered each task set before them.

Sometimes ambition and circumstances lead one of these technicians a little beyond his depth. There was the case of a boy who was quite adept at administering an anesthetic, particularly by hypodermic needle. His preoccupation with the latter instrument led to an unusual bit of therapy when the native was enjoined to treat a tumor during the white doctor's absence. After gazing at the swelling a moment, he prescribed and administered an intravenous injection *of iodine*. Apparently the patient suffered no drastic after-effects and eventually recovered.

The use of selected work-boys in technical jobs may lead to the rise of an African "white collar class." But for the most part, the detribalized native is drawn via modern transportation to the mines and other industrial districts where he becomes a member of a steadily increasing proletariat. One reason for this movement is the fact that the native chiefs are rather heavily taxed by the European government to whom they owe allegiance. The chiefs, in turn, tax their underlings, who are frequently driven into town to earn the money. It is this half-absorbed type that startled our resurrected Stanley by embracing the white man's wardrobe with such misguided violence. And he is truly a "man without a country." For once the native falls into the habit of city life he gradually loses the desire to go back to the tribal village and often forgets or abandons the family he has left behind. Since monogamy is insisted upon by the missionaries, the natives seldom settles down in the city but, like laboring elements in our own culture, falls into the vicious circle of spending what

Continued on page 311

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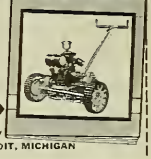

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LETTERS—*Continued from page 257*

tion of the earth's axis, a change so gradual that no one living at the time would notice it apart from scientific observations. In case your time permits and the author does not object, I should appreciate an explanation of the Ice Age by Doctor Reed. (Rev.) I. T. Hawk.
Grovetown, Ga.

Dr. John C. Reed answers this query as follows: "Rev. Hawk's idea that the Ice Age was the result of a change in the inclination of the earth's axis has been suggested many times. It is not now generally held, at least as the principal cause of the Ice Age, because, among other things, the distribution of past glaciations apparently does not fit any such hypothesis of polar wandering.

"Geologic literature contains a number of hypotheses, but their relative adequacy is not yet well understood. The latest great "Ice Age," the Pleistocene Epoch of geologists, and earlier ice ages, were probably the result of a combination of many and complex factors.

"The hypothesis that perhaps is most generally subscribed to as a major cause of widespread glaciation associates glaciation with differences in the amount of energy emitted by the sun at different times. These differences must have a profound effect on the earth's climate.

"Other hypotheses include those involving differences at different times in the amount of carbon dioxide in the atmosphere; movements of the earth's crust; volcanic eruptions; and the precession of the equinoxes, or the changing time of year that the earth is nearest the sun."

* * *

Sirs:

. . . I take a good many magazines but none are read with more enjoyment than yours—solid *serious* enjoyment.
Fred Streever.
Ballston Spa, N. Y.

* * *

Sirs:

The cover of the April issue of Natural History is really a thing of beauty.

I have been most interested in the series of biographies of the Museum staff members which have appeared in the last few issues of the magazine. May we have more? J. B. Sommer.
Peoria, Ill.

More are planned.—Ed.

* * *

Sirs:

. . . The cover of the current issue of Natural History is excellent. That frog is a very handsome individual.
Charles B. Lawler.
Los Angeles, Calif.

Photo by Ralph Bradford

Sirs:

This photograph, taken by a friend of mine, shows two baby hummingbirds and the parent bird in their nest. It was taken at a distance of twelve inches from the nest with a 4x5 Speed Graphic, f/4.5 Zeiss lens stopped to f/22, on E.K. Tri-X Panchromatic film. The picture was taken late in the afternoon with the use of a Wabash 40,000 Press bulb synchronized at 1/200 second. The photographer attached a 25-foot electric cord from the flash to the distant flash tripper button. After setting the camera in focus he stepped back and set off the flash.

As you can see, the photographer succeeded in setting up the camera without the birds' being disturbed by his operations. As soon as the flash went off, however, the parent bird became wildly excited and flew off, leaving her babies to cope with the UNKNOWN as best they might. M. Walsh.
Santa Barbara, California.

© James L. Clark

WILD HORSES, sculptured by James Lippitt Clark: a bronze accepted by the National Academy of Design for its recent exhibition. Doctor Clark, who is Director of the American Museum's Department of Arts, Preparation and Installation, was inspired to create this piece when he saw many wild horses while on an expedition collecting mountain lion for the Museum last spring in southern Utah. The group represents a stallion herding a bunch of wild mares away from danger. The model is 11 inches long and 6½ inches high. Doctor Clark received the Speyer Memorial award of 1930 for animal sculpture in the Academy Exhibit of that year.

ANNULAR ECLIPSE OF THE SUN
April 7, 1940

Photographed from a plane at an altitude of 13,000 feet, over Kingsland, Georgia—in the center of the path and at the center of the annular phase. Photographs were made with an Akeley Motion Picture Camera with a 12-inch telephoto lens by Peter A. Leavens with the co-operation of Clyde Fisher.

MAY MUSEUM BROADCASTS

"This Wonderful World" (information quiz on Natural History subjects), Mutual Network on Saturday mornings at 11:15, E. S. T., (after May 4th at 12 noon, Daylight Saving Time) with Robert Emory and Robert Coles.

JAMES ARTHUR LECTURE

The ninth annual James Arthur Lecture on the evolution of the human brain will be given by Dr. John F. Fulton of Yale University at the American Museum on Thursday evening, May 2, 1940, at 8:15. The title will be "A Functional Approach to the Evolution of the Primate Brain." Doctor Fulton will especially emphasize the growing dominance of the cerebral cortex in brain evolution. The lecture will be illustrated and it is open to the public.

THE VANISHING AFRICAN

—Continued from page 309

he earns where he earns it. He acquires a taste for commercial entertainments and satisfactions, eventually losing all spiritual as well as actual contact with his native community. Despite a marked increase in illegitimacy, which many attribute to the missionaries' ban on the old-time polygamy, this migration to the cities has coincided with a sharp decline in the entire native population. Competent observers declare that the general demoralization of the African is responsible. They feel that he has been thrown too suddenly into a getting and spending economy before being taught how to handle and evaluate money. They further assert that his subjection to Christian restrictions has come before he has had sufficient time to adjust himself to Christian temptations. Lastly, the native's folk-religion has been destroyed—deliberately in some cases and through incidental material pressures in others. Since there used to be very little distinction between sacred and secular in the tribal social structure, the religious loss includes most of the old way of life. This has been very deeply felt, and to make matters worse, there is nothing to take its place. All that remains, says Westermann,* "is a crude belief in magic, a fear of spirits, and some undigested European ideas. The reverence for that which is greater than man has been extinguished."

* Westermann, Diedrich, *The African Today*, Oxford University Press, 1934.

INFORMATION TEST

A few informational high spots that may be gleaned from this month's NATURAL HISTORY

Correct answers on page 316

1. What is wrong with a picture showing a penguin and an Eskimo on the same cake of ice?

2. The glaciers of the last Ice Age were large enough to lower the level of the sea appreciably.

   True..... False.....

3. Does any sound ever accompany the northern lights?

4. Is the bald eagle really bald?

5. What animal can stick its tongue out farther than the length of its body?

6. Displays of northern lights usually occur in winter.

   True..... False.....

7. Is the size of the brain a measure of intelligence?

8. What is the southern equivalent of the northern lights?

9. If you were bitten by a tarantula, you would have approximately only one chance out of ten of living.

   True..... False.....

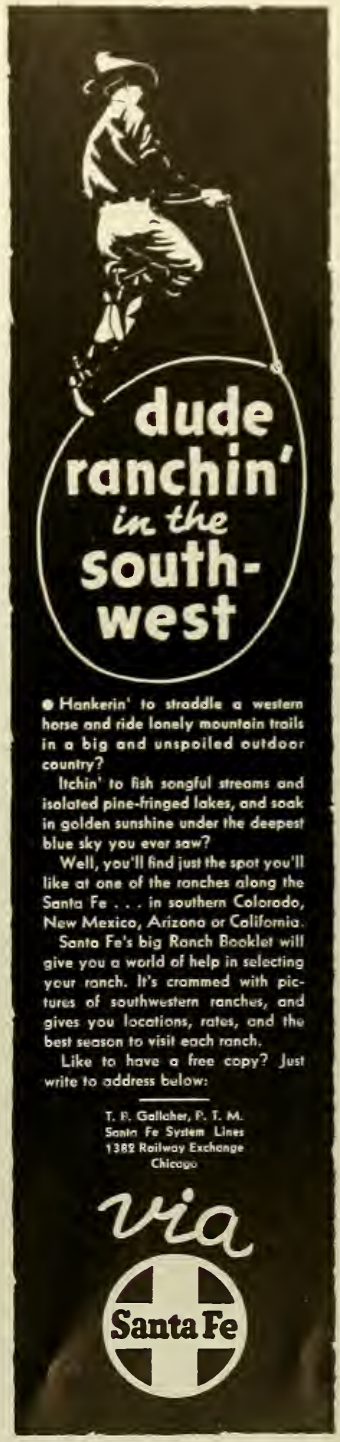
10. The word "altricial" means the opposite of

    (a) Meek

    (b) Selfish

    (c) Precocious

11. Describe the sound made by an earthworm



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RACE, LANGUAGE AND CULTURE

- - - - - - - - - by Franz Boas

The Macmillan Company, $5.00

FOR this book, Professor Boas has selected from his own works those theoretical articles and reports of his specific investigations which best embody his approach. Students of human thought are exceedingly fortunate to have in one volume the essence of research which has included all the fields—physical anthropology, ethnology, linguistics and archaeology—which taken together form the composite science of man. The presentation is lucid and authoritative and the book may be read with the assurance that no uncomprehending editorship has distorted an argument or misplaced an accent.

It presents a record of a scientific approach, so rigorous in its demands upon evidence that articles written in 1888 stand, without need of revision, beside articles written in 1932. The same standards governed the conclusions expressed in both, and so integrated them that it is possible to trace the same emphasis throughout work in all the many fields of investigation into which his unflagging pursuit of understanding has led him. Two themes run through all his work: the flexibility of *man* and the limitations under which individual *men* labor who attempt to understand and state that flexibility. The theme is the same whether it be an article on obscure American Indian languages in which Professor Boas is showing how phonetics, grammer and vocabulary are not bound together inescapably but that each may vary freely and separately, or an article on problems of the relationship of physical type and culture in which he is demonstrating that there is no evidence for the interdependence of psychological function and physical structure, or in his studies of human customs in which he has been at infinite pains to show the extraordinary variety and complexity of the social forms within which man can survive. Man, as to his body, the language in which he clothes his thought and the customs with which he builds his world is extraordinarily plastic and flexible. This is Professor Boas' scientific conclusion and from this he draws the moral that we, social scientists, philosophers, the man and woman in the street, can learn one important lesson from such a lifetime of research as is summarized here; that we, being flexible, have been most thoroughly moulded in terms of the culture in which we live. It is our task as thinking beings to learn to analyze the extent to which we are creatures of our period even in our most objective and detached judgments upon our fellows and upon society. Thus the more that we recognize the potentialities of human beings, the more we ourselves must accept our limitations.

MARGARET MEAD.

THE ROAD TO MODERN SCIENCE

- - - - - - - - - By H. A. Reason

D. Appleton-Century Company, $3.00

THE average intelligent reader has had somewhere in his educational career a course in physics, chemistry, or biology, but has forgotten most of it. The average scientist has had similar courses, and today most of them are to him as remote to his current knowledge and experience as those elementary courses are to the layman. For both groups, a book like this is interesting reading, to remind or to teach relationships forgotten or never known. Too few scientists of today know or care anything about the long course of history leading to their present knowledge. Many are but faintly familiar with sciences other than their own. For such as these, *The Road to Modern Science* is serviceable as a review or for unlearned facts generally regarded as too elementary for expression.

The writer has attempted to include in this 300-page book an appraisal of the work and importance of all the early scientists: Plato, Aristotle, Pythagorus and Euclid, to mention a few; and then having built her high road, to trace the forks as specialized sciences divided and subdivided from it. It is, naturally, an impossible project, and each reader will doubtless find many gaps which he thinks unpardonable. But for all that, it is well done and too much detail cannot be asked or expected in a book intended for the popular reader.

The end papers show an interesting geographical and chronological sequence of the progress of scientific knowledge through Babylon, Phoenicia, Egypt and Greece. In conclusion, a summary lists the names discussed in the text and briefly notes again their principal contributions.

F. H. POUGH.

COSMIC RAYS

- - - - - - - - by R. A. Millikan

Macmillan, $2.50

THOSE who are interested in modern physics will welcome this little volume by one who has been internationally honored for his research on the subject. Dr. Robert A. Millikan is Chairman of the Executive Council of the California Institute of Technology, and Director of the Norman Bridge Laboratory of that institution. In 1923 he won the Nobel Prize in physics.

The book consists of three lectures on cosmic rays, first given as the Page-Barbour lectures of the University of Virginia in 1936, then revised and given in 1937 as the John Joly lectures at Trinity College, Dublin. Again they have been revised in the light of progress in this field, and have now been brought up to the spring of 1939.

The first lecture, entitled "The Discovery of Cosmic Rays and Its General Significance," is popular enough for the layman. It is a fascinating discussion of the scientific approach to knowledge and un-

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derstanding—a gem of clear, nontechnical exposition. The second lecture, "Super-power Particles," and the third, "The Earth's Magnetic Field and Cosmic-Ray Energies," although quite detailed, contain much interesting evidence on the nature and behavior of the various electrified particles, and upon the mechanism of origin and the possible place of origin of the cosmic rays. It is needless to state that we do not yet know how cosmic rays are formed or where they come from, but scientists are gradually wresting from nature these secrets. One is intrigued by Doctor Millikan's statement that a hundred or more super-power particles (photons, electrons, or both) shoot each minute through the head of every person living on the earth.

CLYDE FISHER.

SOILLESS CULTURE, SIMPLIFIED

- - - - - - - - - by Alex Laurie

Whittlesey House, $2.50

DURING the past two years I have had the pleasure of reading a number of books and articles dealing with the growth of plants in liquid media containing the elements essential to plant growth. And from each I have learned much. When *Soilless Culture, Simplified* came into my hands I thought that it could contain little that was new, or that might be of real interest. In this I was mistaken.

A feature of the book that appeals to me is the thorough consideration given to the growth of plants in soil and the discussion of the various needs of plants, of their diseases as a result of deficiency or excess of the various elements necessary for their growth, of the symptoms of these diseases, and definite suggestions for their cure. Much of this is elementary—so well known and so natural to the man who grows plants that he does not consciously think of it—but it forms the basis of successful gardening. Without this knowledge, the amateur is certain to have many failures that seem entirely inexplicable.

In soilless culture a number of media may be used: sand, gravel, cinders, excelsior, and so on, in addition to plain liquid. Mr. Laurie (Professor of Horticulture, Ohio State University), shows a preference for gravel, or washed or unwashed sand, but does not neglect the purely liquid method. There can be no doubt that the use of sand or gravel has advantages over the latter, particularly by the amateur, since the need of special equipment is reduced, and the aeration of the roots is taken care of with much more ease.

In soilless culture there are certain crops and plants that can be grown satisfactorily and profitably. These are discussed in detail. There are given, also, methods for testing the soil, or media, for deficiency of essential elements, numerous formulae for making nutrient solutions and mixtures, and warnings against expecting too much in the way of results. The author thinks that soilless gardening may have little value in the home and outdoors, except as a hobby, but that as such it has possibilities that make it most fascinating.

The authoritative, simple discussion of the whole subject will prove appealing to anyone interested in growing plants.

C. H. CURRAN.

THE SPIDER BOOK

- - - - by John Henry Comstock, revised and edited by W. J. Gertsch

Doubleday, Doran, $6.00

MANY people are Miss Muffets if, indeed, the little girl was really so silly as to have been frightened by a spider. The only spiders in this country whose bites seriously affect humans are the Black Widow, sometimes common, especially in the South, and possibly our other but very rare species of *Latrodectus*. The fierce-looking "tarantulas" rarely bite humans and, when they do, the effect is not more serious than a severe wasp-sting.

Spiders are not insects but their behavior rivals that of insects. The beautiful orb-web of some, the secluded retreats of others, the courtship dances of the jumping spiders, the maternal behavior of all, the ballooning of the newly hatched of many, and other specialized activities known and still unknown are at our very doors to be seen by those who are free from the notion that spiders are "hideous."

For nearly 30 years Comstock's *Spider Book* has been *the* reference book for those who were interested in American spiders and the inspiration that led others to acquire that interest. Unfortunately, it was recently out of print and, of course, it had become somewhat out of date; but we now have this new edition revised by Dr. W. J. Gertsch of this Museum and with such additions as make it once more an ample guide to the families, to practically all the genera, and to many of the species of American spiders and their near relatives. In addition to notes throughout the book, there is a detailed discussion of anatomy and a very readable summary of habits.

FRANK E. LUTZ.

THE SHADOW OF ATLANTIS

- - - - - - - by Col. A. Braghine

E. P. Dutton & Co., $3.50

THE SHADOW OF ATLANTIS is an imposing addition to the array of mystic archaeological literature. The culture of the American Indian is pitifully distorted when seen through the eyes of believers in a lost continent and lost civilization, be they Atlanteans who lost their continent in the Atlantic or Mu-ites, whose magic civilization sank beneath the waves of the Pacific. Neither group avails itself of the fruits of modern archaeological or anthropological research. Tenuously supported data are used as proofs as in the case of this volume where two forgeries of antiques are used as frontispiece.

The interesting feature of the Atlantis theory is not in its validity, which has been abundantly disproved, but in the reason why people like to read such garbled mixtures of fact and fancy, culled from centuries of conjectural writing. We love mystery and we love simple explanations and perhaps, in the combination of the two, we have the key to the popularity of this type of writing. For the Atlanteans this book is superb; for a serious reader, whose interests lead him to the story of civilization, it is just another fantasy.

G. C. V.

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LAND BELOW THE WIND
- - by Agnes Newton Keith, 1939

Little, Brown and Company, $3.00

LAND BELOW THE WIND is a lively and amusing descriptions of the varied experiences, which four years in North Borneo, as the wife of a British Forest Reserve Officer, brought to its author. The Chinese and Malay servants, the many wild pets and the problems of keeping house in a foreign land, are all made vivid and interesting by Mrs. Keith's very individual style of writing.

The high spot of the book is a day by day account of an exploring trip through the jungle, by boat and on foot, which lasted four weeks. The joy of gliding along beautiful rivers, with picturesque Malays plying the paddles, was tempered by the discomfort of frequent wettings from rainstorms which came without warning, and cleared away with equal suddenness; while the annoyance of mud and of biting and stinging insects had to be accepted as part of the daily routine. A hard trip and partly enjoyed at the time, but rewarding Mrs. Keith with an intimate knowledge of the country and its people, which could have been gained in no other way.

The scientific expeditions which passed through Sandaken and were given advice and entertainment, are grouped by Mrs. Keith into two classes—"those who took care of themselves, and those whom we took care of"—and Mr. and Mrs. Martin Johnson are cited as a shining example of the first group. Tribute is paid to Martin Johnson's marvelous efficiency and to Osa Johnson's skill as a cook, her open-handed generosity, and her absolute fearlessness with wild animal pets. Very intelligent and dignified is the story told to Mrs. Keith by an aborigine of North Borneo of the Murut tribe, of his experiences in New York during the three months he spent there in charge of Martin Johnson's animals.

The book is illustrated with drawings by the author.

H. C. RAVEN.

THROUGH CHINA'S WALL
- - - - - - - - - by Graham Peck

Houghton Mifflin Co., $3.50

THOUGH written as a popular travel book, this has much wider interest because of its comprehensive picture of China just before the War. Graham Peck stopped at Peking in 1936 on his way around the world, and liked the city so much that he stayed several months. He only left there to visit Inner Mongolia and other parts of China, returning a year later to witness the first months of fighting.

Apparently he not only had the ability to get on well with all types of people, Chinese farmers, coolies and shopkeepers, Mongol herdsmen, tribesmen and Tibetans, but had a remarkable sense of observation, and the ability to make the reader share his experiences. With a sound critical sense balanced by a keen sense of humor, and an engaging frankness which manages to avoid bad taste, he goes into every aspect of life among the peoples of China as he found them.

In two of his more philosophical digressions, Mr. Peck remarks that he has no sympathy for the popular ideas of China as a romantic and mysterious nation or as an uncomfortable land full of inhuman people. On this basis, he not only explodes some of the Western notions about China, but resists any temptation to romanticize, and writes simply and naturally of the every day life of the people, inserting occasional bits of folklore and history to give perspective.

To judge by some of his portraits of jewel-decked Mongol and Tibetan tribesmen, it must often have been difficult for him to exercise this admirable restraint. These portraits and the two-page landscapes in pen and ink add greatly to the vivid impression created by the smoothly running narrative. Although he mentions having done a great many portraits in color, the publishers have selected only fourteen, and have unfortunately reproduced them in monochrome. Some of the others have been redrawn in pen and ink, but the tiny scale obscures both physical type and costume details, detracting from the obvious anthropological interest of the originals.

The only weaknesses in this consistently fine book are the too hasty generalizations about some of the tribes of West China. In his conclusion Mr. Peck tells us that he plans to return to China to learn more about these peoples who are now in danger of being absorbed or driven out by the hordes of refugees from the Eastern provinces. We can look forward then to another book, and more portraits, which we hope will be printed in color.

S. V. R. CAMMANN.

FALCONRY
- - - - - - By William F. Russell, Jr.

Charles Scribner's Sons, $2.50

FALCONRY is a noble, picturesque pastime in itself and has many attributes that make it an interesting and pleasure-giving sport. During recent years there has been a growing interest shown in this hobby, principally amongst the younger sportsmen. A few years ago there was not a book on this subject that was not out of print.

Falconry, by William F. Russell, Jr., is a practical handbook, not only for beginners, but containing a lot of useful hints that more advanced falconers would do well to follow. The book contains 175 pages. It is fully illustrated with photographs and drawings and has a glossary, index and bibliography. The first chapter is on falconry in general and the succeeding chapters treat kinds of hawks used in falconry, methods of trapping, manning and training passage and eyess falcons, crow hawking, magpie and game hawking. There is a chapter on the small falcons and accipiters and, in fact, a general thesis on the practice of modern falconry from the taking of the wild hawk to treatment of ailments to which these birds are subject, including a comprehensive description of hawk's furniture, how to make it and use it.

Unfortunately few localities in the East are suitable for this sport and on the prairies and open spaces in the Middle West, winged game is not over abundant. Falconry is not recommended as a pastime for the average sportsman, but those with suitable surroundings, sufficient time and sincere interest, and those gifted with a reasonable amount of patience should be encouraged.

There is a considerable difference of opinion among falconers as to the actual procedure and each falconer has his own pet routine in the management of hawks. The end in view, however, is the same—to produce a high-flying, obedient hawk in first-class condition. The rest is up to the hawk itself.

GEORGE G. GOODWIN.

THE AIR AND ITS MYSTERIES
- - - - - - - - - by C. M. Botley

(American editon arranged by Hanor A. Webb)

D. Appleton-Century Co., $3.00

THIS book covers many subjects in meteorology and borderline topics, especially those features that are non-technical. The author begins with the character of the atmosphere, its function in life, and movement of air on the planet, together with types of wind and their action.

The next few chapters describe the nature and kinds of clouds, rain and its causes, also rainbows and other effects such as halos. Then follow the formation and results of storms, together with a consideration of lightning and precautions, and rare phenomena like ball lightning and St. Elmo's fire. Other chapters follow with a treatment of regions of extreme weather, justification or refutation of various weather sayings, a discussion of lows and highs, forecasts, climatic types and ice ages.

Miss Botley gives a good account of visibility and optics of the atmosphere, irregular refraction and mirage. An interesting chapter on the realm of sound touches on sound travel in the atmosphere, sound-ranging apparatus, and air-waves in gunnery. Many pages are given to airships, planes, and animals that fly. The last chapter is on the unknown regions of the upper atmosphere, the stratosphere, the ozonosphere, the ionosphere, cosmic rays, ultra-violet radiation, ionization, auroras and auroral sounds.

HUGH S. RICE.

DESERT WILD FLOWERS
- - - - - - - by Edmund C. Jaeger

Stanford University Press, $3.50

TRAVELERS through the deserts of the Southwest have always wished for a handy guide to the plants of those regions. This attractive reference book, illustrated by line drawings of each species, gives short, interesting accounts about 764 plants of the Mohave and Colorado deserts. It is disappointing to find that there are no keys to help in the identification of the plants; and the amateur, unacquainted with the families of flowering plants into which these desert plants are arranged, must determine the plant which he has in hand by comparison with all of the drawings.

J. W. THOMSON, JR.

LONG SHOTS

By Charles H. Coles
Chief Photographer, American Museum of Natural History

DISTANCE lends enchantment, it is said, but this certainly is not true of photographs unless the principles of long-distance picture taking are carefully observed. A successful long-distance shot is something to be proud of, and usually interests everyone who sees it. Let's look into the problems that make this type of picture-taking a little different from the usual run of scenic photography.

Haze

This is a loosely defined term that is frequently used but is little understood. Photographically speaking, haze is the blue shimmer of distance. You can see through it clearly. It is the color of the air between you and the distant object; it is not mist, dust, smoke, or fog; it is blue air.

If you were to take a picture of a distant mountain without any preparation, the haze would register as a strong white veil obscuring most of the details. Because most films are more sensitive to the color blue than to any other, the blue air between you and the mountain registers strongly, much more strongly than you see it. The final print would be extremely flat and lacking in contrast, a disappointing record of perhaps a magnificent vista.

Filters for haze

Inasmuch as haze is the equivalent of a blue veil, penetration of this color will enable us to take a better picture of distant objects. A study made jointly by a large filter manufacturer and the Army Air Corps resulted in the production of three filters that are remarkably effective in removing the blue air color, so that distant objects could be photographed clearly.

The Aero 1 filter was the lightest of the three filters designed to remove the effect of haze. The filter factor is low, so that exposures need not be unduly prolonged. For more effective haze penetration, the Aero 2 filter was made. For the maximum removal of the blue color the Minus Blue filter shows remarkable efficiency. All these filters are yellow in color which is the complementary color of blue.

The Pola Screen is also very effective in removing the blue color of distance, but only when you are photographing approximately at right angles to the sun. In combination with one of the afore-mentioned filters, a distance penetration almost equal to infra-red photography may be achieved without the bizarre results associated with the latter.

Color photography

Naturally it is impossible to use a colored filter when taking color pictures. A Pola Screen will remove a great deal of the haze and provide good penetration. The haze filters sold for color photography are practically useless for haze. They merely succeed in making all the colors in the picture somewhat redder. What they do is remove the ultra violet that would ordinarily register as blue in the picture.

QUICK LUNCH

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When using long focus lenses and telephoto lenses the same principles of haze penetration must be kept in mind. When photographing an animal that is a long distance off, it must be remembered that a large body of air intervenes between the lens and the subject. This air reflects blue light into the camera and causes the shadows to brighten up to the point where the desirable contrast of the picture is entirely destroyed. All detail in the shadows is obliterated by this veiling action. A filter removes the blue "fogging" light and causes the picture to brighten up and regain the sparkling characteristic of a close-up.

Filter optics

Filters that are used with regular lenses do not need any extraordinary degree of optical accuracy, but it is surprising how poorly an ordinary filter works on a telephoto lens. In some cases, the definition of a telephoto lens has been ruined completely by the use of a poor filter. A poor filter is not necessarily a cheap one. Good ones have been known to develop severe distortion by the slow relief of internal strains set up during manufacture.

The best way to test a filter is to take two pictures of the same distant object, one without the filter and one with, applying the proper increase of exposure. The negative made with the filter, when examined under a magnifier of at least six power, should not be appreciably more blurred than the unfiltered negative.

Try some long distance shots soon from the top of some tall building or mountain. Use a tripod for extreme steadiness, a small aperture for good definition, and a filter for penetration. You'll be fascinated by the result.

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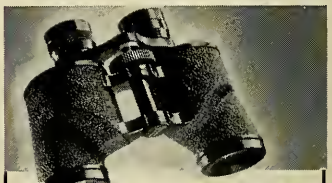
Answers to Questions on page 311

1. There are no penguins in the arctic. See page 264
2. True. The glaciers took so much water from the sea that they lowered its level over 300 feet, and islands now isolated, like England, were connected with the continent. See page 286
3. Yes, a sound that has been described as hissing, crackling, rushing, or the rustling of leaves. See page 275
4. No. The head and neck of the adult are feathered with white, giving a mistaken impression of baldness from a distance. See page 278
5. The chameleon. A seven-inch chameleon has been known to eject its tongue twelve inches. See page 262
6. False. More are seen in winter, but only because the nights are longer. See page 275
7. No. Neither racially nor individually is the size of the brain a safe measure of intelligence. See page 283
8. The aurora australis. See page 272
9. False. The venom of a tarantula is of a character which is virulent to cold-blooded animals but has little effect on warm-blooded animals, including man. Its bite may be compared to a wasp's sting. See page 313
10. (c) Altricial birds are those which require care for some time after hatching. The technical opposite as applied to birds is "precocial." See page 270
11. See next month's NATURAL HISTORY for answer



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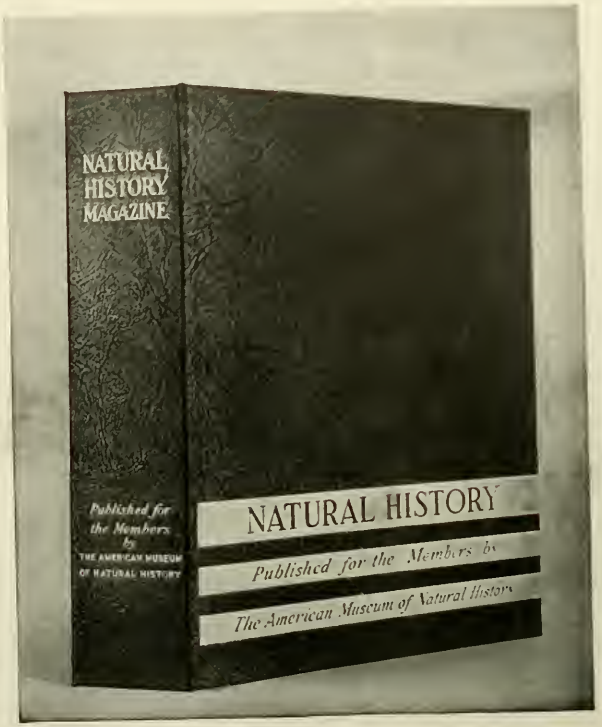

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